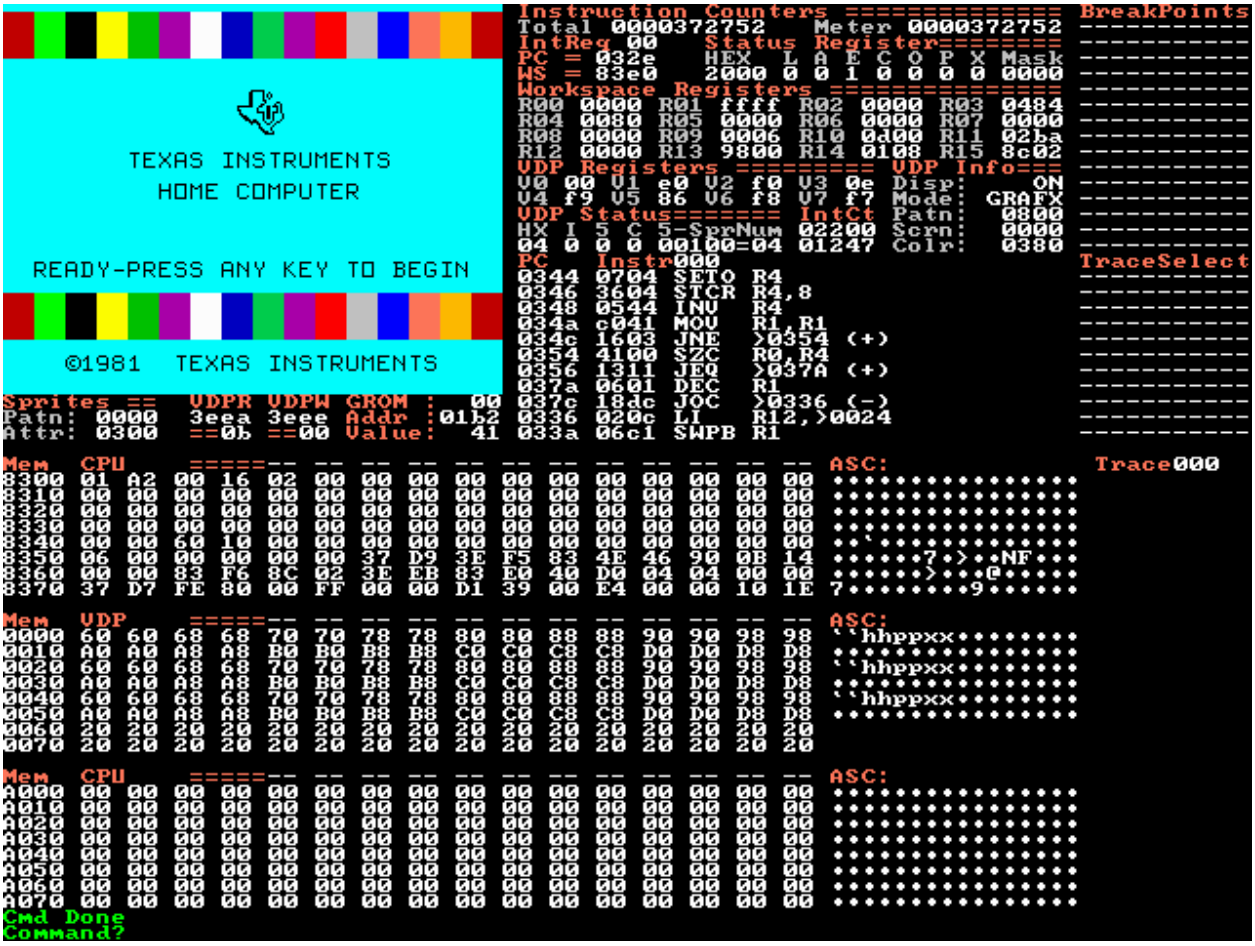
Texas Instruments Home Computer



PC99

IBM PC emulator for the Texas Instruments TI-99/4A

User Manual

Stage 6

TEXAS INSTRUMENTS
HOME COMPUTER

PC99
User Manual
Stage 6

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Table of Contents

1. Quick start 1
1.1. Installation 1
1.2. Configuration 2
1.3. 99/4A emulator 2

2. Introduction 3
2.1. Features 3
2.2. Additional features 6
2.2.1. PC99 debugger 6
2.2.2. PC99 utilities 7
2.2.3. PC99 disk utilities 7
2.3. Features available by product 10
2.4. Hardware requirements 11
2.5. Software requirements 11
2.6. Terminology 12
2.6.1. Keystrokes 12
2.6.2. Hexadecimal values 12
2.6.3. DOS commands 12
2.6.4. Disk Densities 13
2.6.5. Fast PC 13
2.6.6. ASCII editor 13
2.6.7. Protected mode 13

3. Documentation 15

4. Supplied software 16

5. Installation 17
5.1. PC99 tree 18

6. Configuration 24
6.1. General information about using CFG.EXE 25
6.2. RS232 26
6.2.1. Display RS232 mapping 27
6.2.2. Change RS232 mapping 27
6.2.2.1. Select PC COM port to map TI RS232/1 to 28
6.2.2.2. Select PC COM port hardware address 28
6.2.2.3. Select PC COM port hardware interrupt 29
6.2.3. Change PIO 30
6.2.3.1. Select PC LPT port to map TI PIO/1 to 30
6.2.3.2. Select PC LPT port hardware address 30

6.2.3.3. Select PC LPT port hardware interrupt 31
6.3. Sound 32
6.3.1. Standard PC 32
6.3.2. Sound Blaster 32
6.3.3. Display sound setting 33
6.3.4. Change sound setting 33
6.3.5. Sound Blaster 34
6.3.5.1. Display Sound Blaster status 34
6.3.5.2. Display Sound Blaster register variables 34
6.3.5.3. Change Sound Blaster register variables 35
6.3.5.4. Display Sound Blaster noise variables 37
6.3.5.5. Change Sound Blaster noise variables 37
6.4. Joysticks 40
6.4.1. Display joystick mapping 40
6.4.2. Change joystick mapping 41
6.4.2.1. Read new calibration values from joystick 42
6.4.2.2. Use old calibration values 42
6.4.2.3. Display old calibration values 43
6.4.3. Display joystick port 43
6.4.4. Change joystick port 43
6.4.5. Test joystick 43
6.5. System 45
6.5.1. Display system variables 46
6.5.2. Change system variables 46
6.5.2.1. Change default debug mode 47
6.5.2.2. Change show startup info 48
6.5.2.3. Change VDP interrupt count 49
6.5.2.4. Change delay value 1 49
6.5.2.5. Change delay value 2 50
6.5.2.6. Change illegal action response 50
6.5.2.7. Change CPU type 51
6.5.2.8. Change VDP type 51
6.5.2.9. Change speech quality 51
6.5.2.10. Change Gramulator emulation 52
6.5.2.11. Set up mini screen 52
6.5.3. Display overlay file 54
6.5.4. Change path of overlay file 54
6.5.5. Select overlay file in \pc99\oly 54
6.5.6. Creating an overlay file 54
6.5.7. Display delay units per clock tick 56
6.6. Disks 57
6.6.1. Texas Instruments Disk Controller 57
6.6.2. Guion Disk Controller 57
6.6.3. Myarc Disk Controller 58

6.6.4. Using CFG.EXE to change disks 58
6.6.5. Using DOS COPY to change disks 59
6.6.6. Copying disks 59
6.6.7. Display disk paths 60
6.6.8. Change disk paths 61
6.6.8.1. Change path for DSK1 61
6.6.8.2. Display \PC99\DSK directory 61
6.6.9. Change disk attached flags 61
6.6.10. Change disk read/write flags 62
6.6.11. Display disk catalog 63
6.6.11.1. Sector 0 information 63
6.6.11.2. Disk Manager catalog 64
6.6.11.3. Disk Manager catalog files only 65
6.6.11.4. p-Code catalog 65
6.6.11.5. Plato catalog 66
6.6.12. Select Plato disk 66
6.6.12.1. Creating compressed Plato disks 67
6.6.13. Display cassette paths 68
6.6.14. Change cassette paths 68
6.6.14.1. Change path for CS1 68
6.6.15. The blank disks — FMT21.DSK and FMT22.DSK 69
6.6.16. The blank disks — PFMT21.DSK and PFMT22.DSK 69
6.6.17. TI or Guion vs. Myarc disk controller 70
6.7. Keyboard 71
6.7.1. Joystick keys 71
6.7.2. Special keys. 72
6.7.3. Display path of keyboard file. 73
6.7.4. Change path of keyboard file. 73
6.7.5. Display key age value. 73
6.7.6. Change key age value. 74
6.8. Console 75
6.8.1. Display paths for console ROM and GROMs 75
6.8.2. Change paths for console ROM and GROMs 76
6.8.3. Configure 99/4A console ROM and GROMs 77
6.8.4. Configure 99/4A v2.2 console ROM and GROMs 77
6.8.5. Configure 99/4 console ROM and GROMs 77
6.8.6. Configure OPA SOB console ROM and GROMs 78
6.8.7. Configure CDC console ROM and GROMs 78
6.9. Peripherals 79
6.9.1. Display peripheral ROMs and GROMs 80
6.9.2. Change peripheral ROMs and GROMs 81
6.9.3. Display peripheral type 82
6.9.4. Change peripheral type 82
6.9.4.1. Memory card 83

6.9.5. Setup peripheral 85
6.9.5.1. Setup peripheral at CRU >1000 (Myarc 512K card) 85
6.9.5.2. Setup peripheral at CRU >1100 (Disk Controller card) 85
6.10. Module 86
6.10.1. Display loaded module names 87
6.10.1.1. Limitations of REVIEW MODULE LIBRARY feature 88
6.10.1.2. Applications that do not read the GROM base address 88
6.10.2. Display loaded module files 89
6.10.3. Change module. 89
6.10.3.1. Dummy module 90
6.10.4. Check all modules (screen report). 90
6.10.5. Check all modules (disk report). 91
6.10.6. Change module count 91
6.10.7. Print module list 92
6.10.8. Set up Super Space bank 93
6.10.9. Display Super Space bank status 94
6.10.10. Set module slot range to "not used" 94
6.10.11. Enable multiple ROM banks 95
6.11. Color 96
6.12. Status 97
6.12.1. Display configuration status 97
6.12.2. Print status to disk file 98
6.12.3. Display PC info. 98
6.13. Save 99
6.13.1. Save configuration 99
6.13.2. Save configuration and quit 99
6.14. Defaults 100
6.14.1. Display PC99 default configuration values 100
6.14.2. Set all configuration values to PC99 defaults 101
6.15. Test 102
6.15.1. Transmit/receive test 102
6.15.2. Modem control register test 103
6.15.3. Terminal emulation test 104
6.15.4. Mouse driver test 105
6.16. Shell 106
6.17. Quit 107
6.17.1. Quit to DOS without saving configuration 107
6.17.2. Save configuration and then quit to DOS 107
6.18. CFG.EXE switches 108
6.18.1. Display console status (/c) 108
6.18.2. Display disk paths (/d) 109
6.18.3. Display joystick status (/j) 109
6.18.4. Display keyboard status (/k) 109
6.18.5. Display or change module (/m) 109

6.18.6. Display or change peripheral (/p) 110
6.18.7. Display RS232 status (/r) 111
6.18.8. Display or change sound (/s) 112
6.18.9. Toggle startup info (/u) 112
6.18.10. Display system status (/y) 112
6.19. How to generate a default PC99.CFG file (CFGGEN.EXE) 113

7. 99/4A emulator 114
7.1. Loading PC99 114
7.2. Quitting PC99 114
7.3. PC99 display 115
7.3.1. TI aspect ratio mode 116
7.4. Connecting devices to the PC COM port 117
7.5. Using serial ports to transfer Basic programs 118
7.6. Controlling sound in PC99 119
7.7. PC99 "card" 119
7.8. Mechatronic Extended Basic II Plus 120
7.8.1. Loading XBII+ 120
7.8.2. Reading XBII+ documentation 120
7.8.3. Using MECHAXB.DSK 121
7.9. PC99 debugger 122
7.10. Debugger commands 125
7.10.1. ?. Help - print command list 126
7.10.2. c. Continue with the program 126
7.10.3. C. Auto-continue without having to hit <Enter> 126
7.10.4. cd. Change disk file 126
7.10.5. cf. Continue for <num> instructions and then stop 127
7.10.6. dm. Dump memory to file 127
7.10.7. dv. Dump video memory to screen 128
7.10.8. dwe. Disk write enable (allow disk writes) 128
7.10.9. dwp. Disk write protect (disallow disk writes) 128
7.10.10. e. Edit mini-screen 129
7.10.10.1. Instruction Counters 129
7.10.10.2. Int Req 129
7.10.10.3. PC 130
7.10.10.4. WS 130
7.10.10.5. Status Register 130
7.10.10.6. Workspace Registers 130
7.10.10.7. VDP Registers 130
7.10.10.8. VDP Info 130
7.10.10.9. VDP Status 131
7.10.10.10. IntCt 131
7.10.10.11. PC Instr 132
7.10.10.12. Mini-screen breakpoints 132

7.10.10.13. Trace Select 136
7.10.10.14. Sprites 138
7.10.10.15. VDPR 138
7.10.10.16. VDPW 139
7.10.10.17. Grom: 139
7.10.10.18. Mini-Screen memory objects 139
7.10.10.19. AMS mapper 140
7.10.11. gploff. GPL opcodes - stop flagging fetches at PC >0078 141
7.10.12. gplon. GPL opcodes - start flagging fetches at PC >0078 141
7.10.13. k. Set keystroke duration 141
7.10.14. kboff. Keyboard wheel off 142
7.10.15. kbon. Keyboard wheel on 142
7.10.16. Load interrupt 142
7.10.17. mod. Mini-screen objects - disable all 145
7.10.18. moe. Mini-screen objects - enable all 145
7.10.19. Q. Quit PC99 and return to DOS 146
7.10.20. s. Single step 146
7.10.21. S. Single step without having to press <Enter> 146
7.10.22. sca. Set CRU address - e.g. 1100 146
7.10.23. sd1. Set processor delay 1 [0 = no delay] 147
7.10.24. sd2. Set processor delay 2 [0 = no delay] 147
7.10.25. sdm. Set debug mode 147
7.10.26. smb. Set Myarc bank 147
7.10.27. soff. Sound off 147
7.10.28. son. Sound on 148
7.10.29. srb. Set RAM bank in cartridge space 148
7.10.30. spr. Sprite info 148
7.10.31. spra. Sprite attribute table 148
7.10.32. sprc. Sprite colors 148
7.10.33. sprd. Sprites draw 148
7.10.34. spri. Sprite intersector array 149
7.10.35. ss. Show status 149
7.10.36. ssq. Set speech quality 149
7.10.37. toff. Instruction trace off 149
7.10.38. ton. Instruction trace on 149
7.10.39. troff. Instruction trace off 150
7.10.40. tron. Instruction trace on 150
7.10.41. v. Set maximum VDP interrupt counter 150

8. PC99 utility programs 151
8.1. Using Read Sector and Write Sector to transfer disks 151
8.1.1. Read Sector/Write Sector example. 152
8.2. Using PC Transfer to transfer disks (DSKMERGE.EXE) 154
8.2.1. PC Transfer example 154

8.3. Checking a PC99 disk (DSKCHECK.EXE) 156
8.4. Cataloging a PC99 disk (DSKDIR.EXE) 157
8.5. Dumping a PC99 disk (DSKDUMP.EXE) 159
8.6. Finding a TI filename (DSKFIND.EXE) 160
8.7. Renaming a PC99 disk (DSKNAME.EXE) 162
8.8. Extracting a TI file (DSKOUT.EXE) 163
8.8.1. DSKOUT format. 163
8.8.2. BAS2ASC.EXE 164
8.8.3. DV802ASC.EXE 164
8.8.4. DIS.EXE. 165
8.8.5. EA5JOIN.EXE. 167
8.8.6. EAC2ASC.EXE 167
8.8.7. EAU2ASC.EXE 167
8.8.8. IV2ASC.EXE. 168
8.8.9. MRG2ASC.EXE. 168
8.9. Extracting TI Forth screens (DSKOUTF.EXE) 169
8.10. Extracting p-System files (DSKOUTP.EXE) 170
8.10.1. PAS2ASC.EXE 170
8.11. Importing DOS files to a TI file system (DSKIN.EXE) 170
8.11.1. ASC2DV80.EXE 171
8.11.2. BIN2PGM.EXE 172
8.11.3. DLCONV.EXE 173
8.11.4. VF2PC99.EXE 174
8.11.5. VD2PC99.EXE 175
8.12. Dumping a TI ROM (DUMPROM.EXE) 176
8.13. Patching a TI ROM or GROM (PATCH.EXE) 177
8.14. Converting Command Modules. 178
8.14.1. GRAM devices. 178
8.14.2. Transferring GRAM files. 178
8.14.3. Conversion example. 179
8.15. Speech utilities 183
8.15.1. Displaying the Speech Synthesizer index (SPDUMP.EXE) 183
8.15.2. Displaying Speech Synthesizer codes (SPCODE.EXE) 183
8.16. Displaying TI-Artist files (ART.EXE) 185
8.16.1. Using ART.EXE to create a slide show 187
8.17. Using PC99 utilities in batch files 188
8.17.1. Bulletin board files 188
8.17.2. Formatting Basic files 189

9. PC99.DSK utility programs 190
9.1. ARC33_1 191
9.2. ASSM1, ASSM2 191
9.3. BSCSUP 191
9.4. DEBUG 191

9.5. DM, DM1, DM2 191
9.6. EDIT1 192
9.7. FILETOPROG 192
9.8. RSECTOR, RSECT_O, SECTLOAD_X, WSECTOR, WSECT_O 192
9.9. MMLOAD_M, MMSAVE_M 192
9.9.1. Loading large TI Basic programs 193
9.10. XLATE_X 194

10. PC99 patches 195
10.1. Console ROM 0: Speeding up the keyboard 195
10.2. Console ROM 0: Bug in interrupt routine 195
10.3. Console GROM 0: Bug in REVIEW MODULE LIBRARY 196
10.4. RS232 card ROM: Reducing timeout 196

11. In case of difficulty. 197
11.1. Can't execute PC99.EXE 197
11.1.1. PMINFO.EXE 197
11.2. Can't execute PC99.EXE 199
11.3. Not enough memory to run PC99 199
11.4. Can't open COMn 203
11.5. Can't open DSKn 203
11.6. Can't open <filename> 203
11.7. Error messages corrupt display 203
11.8. COM port problems 203
11.9. Printer problems 204
11.10. Known problems 204

12. Limited Warranty 205
12.1. Three-month limited warranty — PC99 Software Media 205
12.2. Warranty duration 205
12.3. Performance by CaDD Electronics under warranty 205
12.4. CaDD Electronics Consumer Service Facility 205
12.5. Important notice of disclaimer regarding the programs 205

1. Quick start

This section is for people who hate to read documentation. It contains enough information to get you up and running. However, to get the full benefit of the PC99 product, you should at least try to glance through the remainder of the documentation, especially the section on peripherals, and topics such as TI vs. Myarc disk controller. If you are new to using the Myarc Disk Manager, you should read the document: Myarc Disk Manager Level III Supreme. This is contained in the file MYDMDOC.PDF (Adobe Portable Document Format) or MYDMDOC.TXT (ASCII format).

1.1. Installation

Insert the PC99 distribution disk 1 in your PC floppy drive. The following example assumes you are installing from the A: floppy drive to the C: hard drive. At the DOS prompt:

```
> a:
> install1 a c                [Note: install{one}, not {el}]
```

INSTALL1.EXE builds a directory tree under \PC99 on the C: drive and expands compressed files into it.

Insert the PC99 distribution disk 2 in the A: drive. At the DOS prompt:

```
> install2 a c
```

INSTALL2.EXE expands compressed files into \PC99.

Insert the PC99 distribution disk 3 in the A: drive. At the DOS prompt:

```
> install3 a c
```

INSTALL3.EXE expands compressed files into \PC99.

1.2. Configuration

You must configure PC99 to match your PC hardware, and your personal preferences. You do this by running the PC99 configuration program, CFG.EXE. CFG.EXE is menu-driven and almost every screen has context-sensitive help.

To configure PC99:

```
> c:
> cd \pc99
> cfg
```

Select the section you wish to configure. To get help press <F1>.

One of the main uses of CFG.EXE is to change command modules. Your list of command modules and their associated filenames are in the ASCII file PC99.MOD.

1.3. 99/4A emulator

PC99 is the TI-99/4A emulator program. There are two products:

- PC99 Stage 6 Full.
  Includes PC99.EXE (standard version), PC99A.EXE (accelerated version), all required ROM and GROM files, and a range of utility programs.

- PC99 Stage 6 Light.
  Includes PC99L.EXE (light version), all required ROM and GROM files, and a range of utility programs.

Note: Unless dealing specifically with a particular version, all examples will show PC99.EXE. You should substitute PC99.EXE, PC99A.EXE or PC99L.EXE where applicable.

To load PC99 from the DOS prompt:

```
> c:
> cd \pc99
> pc99
```

To quit PC99, press <Esc>. The current debugger screen is displayed. Press <Q> (upper case q) to return to DOS.

2. Introduction

PC99 is a DOS protected-mode program that runs on a 386 or higher IBM PC or compatible and emulates the Texas Instruments TI-99/4A Home Computer and selected peripherals.

2.1. Features

The table below lists TI-99/4A console and peripheral features and how they are emulated in PC99:

TI-99/4A	*PC99*
TMS9900 16-bit processor	Fully emulated. All 69 instructions and all corresponding addressing modes are implemented.
TMS9918A Video Display Processor	**Memory:** Fully emulated. Up to 16K VDP memory can be addressed. Address wrap from >3FFF to >0000 is emulated. **Write-only registers:** Fully emulated. All eight registers can be addressed. **Display modes:** Fully emulated. All four standard modes (graphics, bitmap, text and multicolor) are available. In addition, the undocumented "half bitmap" mode can be used. **Colors:** Fully emulated in PC VGA mode 19 with PC color monitor. Any pixels that are on in a group of 8 may be one of 16 colors. Any pixels that are off in the same group can be one of 16 colors. **Sprites:** Fully emulated. Up to 32 sprites can be defined.
TMS9901 Programmable Systems Interface	All of the features used on the 99/4A are fully emulated.
TMS9919 Sound Processor	**Standard PC:** Partially emulated. On the 99/4A the TMS9919 chip has three sound channels (1, 2 and 3) and one noise channel. A standard PC has only one sound channel. PC99 only emulates TI sound channel 1. This is a PC limitation. **PC with Sound Blaster:** Fully emulated. The three TI sound channels are played on Sound Blaster channels 1, 2, and 3. The maximum frequency is 16,384Hz. This is a Sound Blaster limitation. The TI noise channel is played on Sound Blaster channels 7, 8 and 9.

TI-99/4A	*PC99*
TI console joystick port	**Standard PC:** Fully emulated using PC ALT function keys (<F1> - <F10>). **PC with game port:** Fully emulated. Depending on the hardware, up to two PC joysticks can be connected to the game port. The PC joysticks are used to emulate the actions of TI joysticks.
TI console cassette port	Partially emulated. A "SAVE CS1" creates a DOS disk file. You cannot load this file with "OLD CS1". You cannot save or load to CS2.
TI console command module port	In PC99 a TI "command module" consists of one or more DOS files. These are loaded into PC memory. You "change a command module" by running the PC99 configuration utility (CFG.EXE). Almost all TI-manufactured command modules are fully emulated under PC99. The same applies to third party command modules. No "lockups" due to bad contacts can occur.
TI command module bank switching	TI, DataBioTics, MBX, and Mechatronics bank switching schemes are fully emulated. Some command modules, such as TI Extended Basic and TI Calc, or DataBioTics TI Workshop, use this feature. MBX command modules which do not require the MBX console are fully emulated in PC99.
TI GROMs	The TI GROM memory map, auto-incrementing actions of a GROM, and GROM memory wrap are fully emulated. Up to 16 banks, each containing 5 8K GROMs, can be loaded. Multiple GROM banks are emulated using the REVIEW MODULE LIBRARY feature in the TI console.
TI console keyboard	Almost every key and shift mode (**SHIFT**, **CTRL**, **FCTN**) on the 99/4A keyboard can be keyed on the PC keyboard. PC99 does not support TI multiple shift modes (for example, **FCTN SHIFT B**).
TI memory map	PC99 fully emulates the TI memory map: >0000->1FFF 8K console ROM >2000->3FFF 8K low memory expansion >4000->5FFF 8K peripheral ROMs >6000->7FFF 8K ROMs in cmd modules >8000->9FFF 8K memory-mapped >A000->FFFF 24K high memory
TI 32K memory expansion card	Fully emulated. This peripheral contains 8K of low memory and 24K of high memory. All of this memory is treated as if it were on the TI fast 16-bit bus.

TI-99/4A	*PC99*
Myarc 512K memory expansion card	Fully emulated. This peripheral contains 32K of memory which is used as standard TI 32K memory expansion. The rest of the memory can be partitioned into a 128K space for Myarc XB II, and a RAM disk and print spooler.
AMS memory card	Fully emulated. You can select whether to emulate the 128K, 256K, 512K or 1Mb version of the card depending on how much PC memory you have available.
Super Space II	Fully emulated. 4 8K banks of Super Space RAM can be enabled at >6000->7FFF. Up to 16 of these 32K banks can be enabled.
TI disk controller card	Fully emulated. The TI disk controller supports up to three drives. Each disk can contain 720 256-byte sectors (DSSD). PC99 uses three DOS disk files to represent the three drives.
Guion disk controller	Fully emulated. John Guion supplied an 8K ROM for the TI disk controller and a hardware kit. After installation the controller can access four drives. Each disk can contain 720 256-byte sectors (DSSD). PC99 uses four DOS disk files to represent the four drives.
Myarc disk controller card	Fully emulated. The Myarc disk controller supports up to four drives. Each disk can contain 1440 256-byte sectors (DSDD). PC99 uses four DOS disk files to represent the four drives.
TI RS232 primary card TI RS232 secondary card	Fully emulated, if the PC has up to two COM ports and one parallel port. The TI ports are: RS232, RS232/1, RS232/2, PIO, and PIO/1. (*Note*: RS232 and RS232/1, and PIO and PIO/1 are the same ports.) PC99 can exchange data at up to 9,600 bps over the PC COMn ports, and can drive a TI compatible printer connected to the PC LPTn port.
Guion RS232 card	Fully emulated. John Guion supplied an 8K ROM for the TI RS232 card. This allowed devices such as TP to be used and have the output sent to standard devices, such as RS232.
PC99 "card"	This is a software only "card", and was not an original TI or third-party peripheral. This "card" contains a DSR for the support of a real-time clock which emulates the CorComp Triple-Tech clock. You can also create your own DSRs for this "card".
TI p-Code card	Fully emulated. You can use CFG.EXE to enable the p-Code card, which consists of a bank-switched 8K ROM and 8 6K GROMs.

TI-99/4A	*PC99*
TI Speech Synthesizer	Partially emulated. All of the software functions of the TMS5200 are fully emulated, but no audible speech is generated. This allows you to run programs that require the Speech Synthesizer.

2.2. Additional features

PC99 includes additional features that are not available on a TI-99/4A:

2.2.1. PC99 debugger

The PC99 debugger displays a TI "Mini-Screen" surrounded by editable objects which allow you to control every aspect of PC99. With the debugger, you can stop any TI application at any time, including during disk access. You can single-step through any TI application, set breakpoints and watchpoints, examine and change any TI addressable memory (CPU, GROM, VDP, and command module space), and read and write the VDP write-only registers. You can also display any sprites being used, including their patterns and locations.

Using the powerful features of the debugger you can debug assembly language programs, examine the workings of the GPL interpreter, and find out how a peripheral device service routine (DSR) works.

Because the PC99 debugger does not use any TI memory, you can debug any TI application, no matter how large. No TI debugger running on a standard 4A can do this.

2.2.2. PC99 utilities

PC99 includes the following utilities:

- ART.EXE: allows you to display TI-Artist files in DOS.
- CFG.EXE: allows you to configure PC99.
- CFGGEN.EXE: allows you to generate a clean configuration file.
- DUMP.EXE: allows you to dump a DOS file in hex and ASCII.
- DUMPROM.EXE: allows you dump a TI ROM in hex to an ASCII file.
- GREAD.EXE: allows you to strip unwanted trailers off files.
- GSTRIP.EXE: allows you to strip unwanted headers off files.
- PATCH.EXE: allows you to make patches to ROMs and GROMs.

2.2.3. PC99 disk utilities

PC99 includes the following disk utilities:

- DSKCHECK.EXE: allows you check the integrity of a TI "disk".
- DSKDIR.EXE: allows you to catalog a TI "disk" from DOS.
- DSKDUMP.EXE: allows you to dump the data of a TI "disk".
- DSKFIND.EXE: finds a disk manager filename using a wildcard selection of disk files.
- DSKIN.EXE: allows you to take a DOS file and store it in a TI "disk".
- DSKMERGE.EXE: allows you to merge files transferred from a 99/4A system into a TI "disk".
- DSKNAME.EXE: allows you to rename a TI "disk" from DOS.
- DSKOUT.EXE: allows you to extract a file from a TI "disk" and store it as a standalone DOS file.
- DSKOUTF.EXE: allows you to extract Forth screens from a TI Forth "disk" and store them as a DOS file.
- DSKOUTP.EXE: allows you to extract a file from a TI p-System "disk" and store it as a DOS file.

The following utilities are used on files extracted by DSKOUT.EXE:

- BAS2ASC.EXE: converts TI Basic or Extended Basic program files into ASCII. The converted file can be loaded into PC Basic. [Not all TI Basic statements are valid in PC Basic.]

- BASFMT.EXE: converts extracted TI Basic or Extended Basic files and formats them to match a program listing on the 28-column TI screen.

- DIS.EXE: disassembles single E/A5 files and E/A5 files that have been "joined" by EA5JOIN.EXE.

- DV802ASC.EXE: converts TI Display/Variable 80 files into ASCII. The converted file can be loaded into a PC word processor, such as WordPerfect.

- EA5JOIN.EXE: loads successive E/A5 files into an equivalent TI memory space and saves as a single file. The output file can be used by the PC99 disassembler, DIS.EXE.

- EAC2ASC.EXE: converts E/A3 compressed format files to ASCII. Shows all tags by name, the load offset, and contents in hex and ASCII.

- EAU2ASC.EXE: converts E/A3 uncompressed format files to ASCII. Shows all tags by name, the load offset, and contents in hex and ASCII.

- IV2ASC.EXE: converts TI Extended Basic INT/VAR 254 program files into ASCII. The converted file can be loaded into PC Basic. [Not all TI Extended Basic statements are valid in PC Basic.]

- MRG2ASC.EXE: converts TI Basic or Extended Basic files saved in INT/VAR 163 (MERGE) format into ASCII. The converted file can be loaded into PC Basic. [Not all TI Basic statements are valid in PC Basic.]

The following utilities are used with DSKOUTP.EXE:

- PAS2ASC.EXE: converts TI p-System .TEXT files into ASCII.

The following utilities are used with DSKIN.EXE:

- ASC2DV80.EXE: takes a DOS ASCII file and converts it to TI-Writer format. This file can be stored in a TI "disk" using DSKIN.EXE.

- BIN2PGM.EXE: takes a DOS binary file containing a TI Basic or Extended Basic PROGRAM file, typically downloaded from a bulletin board, and converts it to a file. This file can be stored in a TI "disk" using DSKIN.EXE.

- DLCONV.EXE: takes a DOS binary file containing a "TI FILES" header, typically downloaded from a bulletin board, and converts it to a file. This file can be stored in a TI "disk" using DSKIN.EXE.

- VF2PC99.EXE: takes a single v9t9 "file in a directory" and converts it to PC99 format.

- VD2PC99.EXE: takes a v9t9 "disk on a disk" and converts it to PC99 format.

2.3. Features available by product

There are two PC99 products depending on the package you purchased:

- PC99 Stage 6 Full.
  Includes PC99.EXE (standard version), PC99A.EXE (accelerated version), all required ROM and GROM files, and a range of utility programs.

- PC99 Stage 6 Light.
  Includes PC99L.EXE (light version), all required ROM and GROM files, and a range of utility programs.

All of the features described above are available in each product, with the following exceptions:

	Full		Light
	PC99.EXE	PC99A.EXE	PC99L.EXE
p-Code	Yes	Yes	No
Multiple GROMs	Yes	Yes	No
Mini-Screen debugger	Yes	No	No

PC99 Stage 6 Full comes with both PC99.EXE and PC99A.EXE. PC99A.EXE offers accelerated performance. This performance increase comes from eliminating the Mini-Screen debugger. You should run whichever version is most suitable for your needs.

The Full product is the equivalent of:

1. A TI-99/4A console with choice of TI-99/4A, TI-99/4A version 2.2, CDC, or OPA ROMs and GROMs and support for up to 16 GROM-based command modules.

2. A Peripheral Expansion Box containing a TI 32K or Myarc 512K or AMS memory card; TI, Guion, or Myarc Disk Controller; TI, or Guion RS232 card; TI p-Code card; and PC99 "card" (real-time clock).

3. A TI Speech Synthesizer (speech functions work, no audible speech is produced).

4. TI Extended Basic, TI Editor/Assembler, Tombstone City, and Mechatronic Extended Basic II Plus command modules. In addition, you have access to the PC99 Mini-Screen debugger.

PC99 Stage 6 Light comes with PC99L.EXE only. You cannot run the p-Code card, multiple GROMs or the Mini-Screen debugger. The performance is the same as PC99A.EXE.

Note: Unless dealing specifically with a particular version, all examples in this document will show PC99.EXE. You should substitute PC99.EXE, PC99A.EXE or PC99L.EXE where applicable.

2.4. Hardware requirements

The PC must have the following hardware:

- 80386 or higher microprocessor (80486 at 66MHz is minimum recommended; Pentium, Pentium II is supported).
- At least 16Mb RAM.
- Color VGA adapter and monitor.
- Disk drive to load software: 3.5" 1.44Mb.
- A hard drive with at least 10Mb free.

Optional PC hardware includes:

- ISA bus: Up to four COM ports based at PC I/O addresses 0x2f8, 0x3f8, 0x2e8 and 0x3e8 to emulate the TI RS232 ports.

  MicroChannel Architecture: Up to eight COM ports based at PC I/O addresses 0x2f8, 0x3f8, 0x3220, 0x3228, 0x3320, 0x3328, 0x3420 and 0x3428.

- A parallel port to emulate the TI PIO port.

- A game port and one or two PC analog joysticks to emulate the TI "digital" joystick port.

- A Creative Labs Sound Blaster for improved sound reproduction.

2.5. Software requirements

The PC must have the following software:

- DOS 5.0, DOS 6.0, DOS 6.2 (or later). Earlier versions of DOS down to 3.3 will probably work. We do not recommended running PC99 from a DOS shell or from a DOS box under Microsoft Windows 3.1 or Microsoft Windows for Workgroups 3.11.

  or

- Microsoft Windows 95/98. PC99 will execute in a DOS box.

Your PC environment must allow PC99 to switch the processor from real mode to protected mode. Some anti-virus programs may prevent this.

2.6. Terminology

2.6.1. Keystrokes

PC keystrokes are shown as <keyname>. For example, <Esc> is the PC Escape key, <Tab> is the PC Tab key, <Ctrl-X> is the PC <Ctrl> key and the <X> key pressed together, and <Shift-Q> is the PC <Shift> and the <Q> key pressed together.

These are distinguished from equivalent TI keys. For example, **CTRL** is the TI CTRL key, and **FCTN** is the TI FCTN key.

2.6.2. Hexadecimal values

When referring to hexadecimal (hex) 16-bit values in the TI world, the TI convention of >NNNN is used. In the PC world the convention 0xNNNN is used. Similarly 8-bit values are >NN and 0xNN respectively.

Example: >2000 is 2000 hex or 8192 decimal.

Example: 0xFF is FF hex or 255 decimal.

2.6.3. DOS commands

When examples of DOS commands are given, the use of the <Enter> key is assumed. The DOS prompt is shown as >.

Example: > cd \pc99

This means that at the DOS prompt (>), type the "cd" command (change directory) followed by "\pc99" and press <Enter>. This will place you in the "pc99" directory, which lives immediately below the root "\" directory.

Note: Most PC users enable the DOS PROMPT function, so that the actual prompt includes the current directory.

Example: C:\PC99>

Note: DOS commands are case insensitive.

2.6.4. Disk Densities

The following table shows the relationship between TI 5.25" diskettes in terms of: disk sides, density, and number of sectors; together with the corresponding mnemonic and description. Most examples in this manual use the mnemonic form.

No. of sides	*Density*	*Sectors*	*Mnemonic*	*Description*
1	1	360	SSSD	single-sided single-density
2	1	720	DSSD	double-sided single-density
2	2	1440	DSDD	double-sided double-density

2.6.5. Fast PC

When reference is made to a "fast PC", we mean a PC that has the typical performance of a 90MHz Pentium, or better.

2.6.6. ASCII editor

When reference is made to an "ASCII editor", we mean an editor such as Solution Systems' Brief, or DOS's EDIT. You typically use such an editor to edit files like AUTOEXEC.BAT or CONFIG.SYS.

2.6.7. Protected mode

The Intel 8088 processor used in the original IBM PC had only one mode of operation. It came to be called real mode. The 8088 processor can address 1Mb of memory. IBM reserved the upper 384K of the 1Mb address space for such things as video memory, and the ROM BIOS. This left a maximum of 640K for DOS applications — the so-called 640K barrier.

Intel's later processors (80286, 80386, 80486 and Pentium) allow for a second operating mode, called protected mode. Perhaps the most important aspect of protected mode is that the processor can address much more memory. When running in protected mode, the 16-bit 80286 processor can address 16Mb of memory, while the 32-bit 80386 and later processors can address 4Gb.

DOS is inherently a real mode operating system. Because of this, DOS applications running on an 80286 and later processors are still restricted to the 640K barrier. Therefore, these systems function merely as faster 8088 systems.

Some attempts to improve this limitation included using expanded and extended memory services to provide limited access to this larger address space. However, if a program wants to treat the memory above 1Mb like conventional DOS memory, it must run in protected mode.

When neither Microsoft nor IBM introduced a DOS-compatible protected mode operating system, DOS extenders were developed by third party companies. A DOS extender is a mini operating system, that can run protected mode applications under DOS.

The DOS extender accomplishes this by executing a real mode stub program that switches the processor to protected mode and passes control to a calling program. PC99 is such a calling program. PC99 runs in protected mode until it requests a DOS service, such as file I/O. The DOS extender then switches back to real mode to satisfy the request, and when done reverts to protected mode.

When PC99 terminates, the DOS extender switches back to real mode and returns control to DOS. These behind-the-scenes tasks are transparent to you.

PC99 uses the DOS/4GW 32-bit extender written by Rational Systems (later Tenberry Software) and supplied with the Watcom C compiler. PC99 therefore requires an 80386 or later processor to run. It will not run on an 80286.

The DOS/4GW extender will identify itself with:

```
DOS/4GW Protected Mode Run-Time Version n.nn
copyright (c) Rational Systems, Inc 1990-94
```

You can suppress this header by setting an environment variable:

```
SET DOS4G=quiet
```

You can do this at the DOS prompt, or in your AUTOEXEC.BAT file.

3. Documentation

The PC99 documentation set consists of:

- *PC99 User Manual* (this document)
  \pc99\doc\pd99doc.pdf in Acrobat format.
  \pc99\doc\pc99doc.txt in text format. Can be read with an ASCII editor.

  How to install, configure, and use all features of PC99.

- *Mechatronic Extended Basic II Plus*
  \pc99\doc\mechaxb.pdf in Acrobat format.

  How to use the Mechatronic Extended Basic II Plus command module features under PC99.

- *Myarc 512K Memory Expansion Card*
  \pc99\doc\myarc512.pdf in Acrobat format.

  How to use the Myarc 512K Memory Expansion card under PC99 and the use of the CALL PART instruction.

- *Myarc Disk Manager Level III Supreme*
  \pc99\doc\mydmdoc.pdf in Acrobat format.

  How to use Myarc's Disk Manager Level III Supreme software under PC99. Includes screen snaps that were not part of the original manual. This software is supplied on \pc99\dsk\pc99.dsk and is invoked through E/A 3 with DSK1.DM.

- *Myarc XB Basic II version 2.12.*
  \pc99\doc\myxbdoc.pdf in Acrobat format.

  How to use Myarc Extended Basic II version 2.12. PC99 must be configured with the Myarc 512K card and the XBII option to use this language.

- *Introduction to the p-System*
  \pc99\doc\pasdoc.pdf in Acrobat format.
  \pc99\doc\pasdoc.txt in text format. Can be read with an ASCII editor.

  An introduction to using the UCSD p-System under PC99. The p-Code peripheral must be enabled to use the p-System.

4. Supplied software

The software supplied in your PC99 package can be divided into five categories:

1. Installation	INSTALL1.EXE, INSTALL2.EXE, INSTALL3.EXE
2. Configuration	CFG.EXE
3. 99/4A Emulator	PC99.EXE, PC99A.EXE (PC99L.EXE)
4. Utilities	About 30 separate programs
5. PC99.DSK Utilities	TI utility programs

Installing PC99 is usually a one-shot process. PC99 is supplied on three diskettes, each with their own install program. Once you have run INSTALL1.EXE, INSTALL2.EXE and INSTALL3.EXE and completed the installation there is usually no need to run the install programs again.

After installation, you should configure PC99 to match your PC hardware, and your preferences. You do this by running CFG.EXE.

After that, you only need to run CFG.EXE when you want to change your PC99 configuration; for example, if you need to change a command module, switch a peripheral, or enable the speech synthesizer.

For everyday use you will run PC99.EXE.

Occasionally you will need to run one of the many supplied utilities.

The following sections of this document cover the five categories above in the order shown.

5. Installation

Note: If you have a previous version of PC99 you should back up all existing files before starting install.

One way to do this is:

```
> c:
> cd \
> mkdir \pc99bak
> xcopy \pc99\*.* \pc99bak /s /e /v
> deltree \pc99
```

This creates a \pc99bak directory, copies all files and sub-directories in the \pc99 directory to \pc99bak, and then removes the \pc99 directory. In the xcopy command,

/s means copy sub-directories,
/e means copy empty files, and
/v means verify the copy.

In later versions of DOS you can simply move the directory:

```
> c:
> cd \
> move pc99 pc99bak
```

PC99 is supplied on three disks, numbered 1, 2 and 3. Each has its own install program: INSTALL1.EXE, INSTALL2.EXE, and INSTALL3.EXE respectively. You must install disk 1 first, then disk 2, and then disk 3.

For each install program, the syntax is:

```
install{1-3} <source drive {A-Z}> <target drive {A-Z}>
```

where

install{1-3} is INSTALL1.EXE if you are installing disk 1, INSTALL2.EXE if you are installing disk 2, and INSTALL3.EXE if you are installing disk 3.

<source drive {A-Z}> is the letter of the floppy drive (no colon) you will install from. Example: A.

<target drive {A-Z}> is the letter of the hard drive (no colon) you will install to. Example: C.

Example: To install PC99 from the A: floppy drive to the C: hard drive, insert the PC99 distribution disk 1 in drive A. At the DOS prompt:

```
> a:
> cd \
> install1 a c
```

Remove distribution disk 1 and insert distribution disk 2:

```
> install2 a c
```

Remove distribution disk 2 and insert distribution disk 3:

```
> install3 a c
```

Please note that you should not execute any of the .EXE files on the distribution disks — except for INSTALL1.EXE, INSTALL2.EXE, and INSTALL3.EXE. The other .EXE files are self-extracting compressed files used by the installation programs.

5.1. PC99 tree

After a successful install, you should have the following files in the PC99 tree. The listings are in DOS sort order.

(F) = full-featured product only
(L) = light product only

\PC99

	CFG.EXE	The PC99 configuration program.
	CFG.MNU	An ASCII file that contains the menus used by CFG.EXE.
	CFGPLATO.MNU	An ASCII file that contains the menus used by CFG.EXE when selecting Plato disks.
	CFGSB.EXE	A 16-bit program used by CFG.EXE to check for the existence of a Creative Labs Sound Blaster.
	DOS4GW.EXE	The Rational Systems DOS/4GW DOS extender that enables PC99.EXE to run in 32-bit protected mode.
	PC99.CFG	An ASCII file that contains PC99 configuration information. CFG.EXE reads and writes this file. PC99.EXE reads this file.
(F)	PC99.EXE	The 99/4A emulator program (standard version).
	PC99.FGF	A font file containing bitmaps of characters used when displaying module overlay files.
	PC99.MMM	An editable ASCII file that contains a master list of modules. You can cut and paste from this file to PC99.MOD when you acquire new modules.
	PC99.MOD	An editable ASCII file that contains your list of modules. CFG.EXE reads this file.

	PC994A.KEY	Keyboard file for emulating a 99/4A. PC99.EXE reads this file.
(F)	PC99A.EXE	The 99/4A emulator program (accelerated version).
(L)	PC99L.EXE	The 99/4A emulator program (light version).

\PC99\DOC

	MECHAXB.PDF	Mechatronic Extended Basic II Plus command module documentation in Adobe Acrobat pdf format.
	MYARC512.PDF	Myarc's 512K Memory Expansion card documentation in Adobe Acrobat pdf format.
	MYDMDOC.PDF	Myarc's Disk Manager Level III Supreme documentation in Adobe Acrobat pdf format..
	MYXBDOC.PDF	Myarc Extended Basic II version 2.12 documentation in Adobe Acrobat pdf format.
(F)	PASDOC.PDF	An introduction to using the p-System under PC99 in Adobe Acrobat pdf format.
(F)	PASDOC.TXT	An introduction to using the p-System under PC99 in ASCII format.

PC99DOC.PDF PC99 documentation in Adobe Acrobat pdf format.

PC99DOC.TXT PC99 documentation in ASCII format. Can be read with DOS's EDIT.

README.TXT An ASCII file that explains how to get to the PC99 documentation.

\PC99\DSK

CS1	A dummy file representing a TI cassette.
CS2	A dummy file representing a TI cassette.
DSK1	A copy of FMT21.DSK.
DSK2	A copy of FMT21.DSK.
DSK3	A copy of FMT21.DSK.
DSK4	A copy of FMT21.DSK.
FMT21.DSK	A file representing a blank TI DSSD disk.
FMT22.DSK	A file representing a blank TI DSDD disk.
MECHAXB.DSK	A file representing a TI DSSD disk containing examples from the Mechatronic Extended Basic II Plus manual.
PC99.DSK	A TI "disk" containing PC99 utilities that allow you to transfer disks to and from a 4A, and other programs.

(F)	PFMT21.DSK	A file representing a blank TI DSSD disk that has been Z(ero'ed for use with the p-System.
(F)	PFMT22.DSK	A file representing a blank TI DSDD disk that has been Z(ero'ed for use with the p-System.

\PC99\DSKUTIL

ASC2DV80.EXE	A program that takes a DOS ASCII file and converts it to TI-Writer format. This file can be stored in a TI "disk" using DSKIN.EXE.

BAS2ASC.EXE A program that takes a TI Basic or Extended Basic PROGRAM file extracted by DSKOUT.EXE and converts it to ASCII.

BASFMT.EXE	A program that takes an extracted TI Basic or Extended Basic file and formats it to match the listing on a 28-column TI screen.
BIN2PGM.EXE	A program that takes a DOS binary file containing a TI Basic or TI Extended Basic PROGRAM file and extracts it to a file. This file can be stored in a TI "disk" using DSKIN.EXE.
DIS.CTL	A default minimal control file used by DIS.EXE.
DIS.EXE	A program that takes an E/A5 file extracted by DSKOUT.EXE, or E/A5 files that have been extracted by DSKOUT.EXE and "joined" by EA5JOIN.EXE, and disassembles them.
DLCONV.EXE	A program that takes a DOS binary file containing a "TI FILES" header and converts it to a file. This file can be stored in a TI "disk" using DSKIN.EXE.
DSKCHECK.EXE	A program that checks the integrity of a TI "disk".
DSKDIR.EXE	A program that catalogs a TI "disk" from DOS.
DSKDUMP.EXE	A program that dumps the data of a TI "disk" to a DOS file.
DSKFIND.EXE	A program that finds a disk manager filename using a wildcard selection of disk files.
DSKIN.EXE	A program that takes a DOS file and stores it as a TI file on a TI "disk".
DSKMERGE.EXE	A program that merges PC-Transfer files into a TI "disk".
DSKNAME.EXE	A program that renames a TI "disk" from DOS.
DSKOUT.EXE	A program that extracts a TI file from a TI "disk" and stores it as a DOS binary file.
DSKOUTF.EXE	A program that extracts TI Forth screens from a TI Forth "disk" and stores them as a DOS ASCII file.
DSKOUTP.EXE	A program that extracts a file from a TI p-System "disk" and stores it as a DOS file.
DV802ASC.EXE	A program that takes a DIS/VAR 80 file extracted by DSKOUT.EXE and converts it to ASCII.
EA5JOIN.EXE	A program that loads successive E/A5 files into an equivalent TI memory space and saves as a single file. The E/A5 files are extracted with DSKOUT. The single file is used by DIS.EXE.
EAC2ASC.EXE	A program that takes an E/A3 compressed format file extracted by DSKOUT.EXE and converts it to ASCII.
EAU2ASC.EXE	A program that takes an E/A3 uncompressed format file extracted by DSKOUT.EXE and converts it to ASCII.
IV2ASC.EXE	A program that takes a TI Extended Basic INT/VAR254 file extracted by DSKOUT.EXE and converts it to ASCII.
MRG2ASC.EXE	A program that takes a TI Basic or Extended Basic INT/VAR163 file saved in Merge format and extracted by DSKOUT.EXE and converts it to ASCII.
PAS2ASC.EXE	A program that converts TI p-System .TEXT files into ASCII.
VF2PC99.EXE	A program that takes a single v9t9 "file in a directory" and converts it to PC99 format.

VD2PC99.EXE A program that takes a v9t9 "disk on a disk" and converts it to PC99 format.

\PC99\MODULES

CON22G0.GRM	The 6K 99/4A console version 2.2 GROM at >0000.
CON22G1.GRM	The 6K 99/4A console version 2.2 GROM at >2000.
CON22G2.GRM	The 6K 99/4A console version 2.2 GROM at >4000.
CON22R0.ROM	The 8K 99/4A console version 2.2 ROM at >0000.
CON4AG0.GRM	The 6K 99/4A console GROM at >0000.
CON4AG1.GRM	The 6K 99/4A console GROM at >2000.
CON4AG2.GRM	The 6K 99/4A console GROM at >4000.
CON4AR0.ROM	The 8K 99/4A console ROM at >0000.
CONCDCG0.GRM	The 6K Control Data Corporation console GROM at >0000.
CONOPAG0.GRM	The 6K OPA SOB console GROM at >0000.
CONOPAG1.GRM	The 6K OPA SOB console GROM at >2000.
CONOPAG2.GRM	The 6K OPA SOB console GROM at >4000.
CONOPAR0.ROM	The 8K OPA SOB console ROM at >0000.
DUMMYG3.GRM	A "dummy" module that loads >00
DUMMYG4.GRM	in all module ROM and GROM locations.
DUMMYG5.GRM	
DUMMYG6.GRM	
DUMMYG7.GRM	
DUMMYR0.ROM	
MEB.GRM	Mechatronic Extended Basic II Plus
MEB1.GRM	command module ROMs and GROMs.
MEB2.GRM	
MEB3.GRM	
MEB4.GRM	
MEB5.GRM	
MEB6.GRM	
P1100R0.ROM	The 8K TI disk controller ROM at CRU >1100.
P1100R1.ROM	A dummy file representing an 8K ROM.
P1300R0.ROM	The 8K TI RS232 Primary ROM at CRU >1300.
P1500R0.ROM	The 8K TI RS232 Secondary ROM at CRU >1500.
P1800R0.ROM	The 8K Thermal Printer ROM at CRU >1800.
P1B00R0.ROM	The 8K PC99 Peripheral ROM at CRU >1B00.
P1F00G0.GRM	The 6K TI p-Code GROM at >0000.

P1F00G1.GRM The 6K TI p-Code GROM at >2000.
P1F00G2.GRM The 6K TI p-Code GROM at >4000.
P1F00G3.GRM The 6K TI p-Code GROM at >6000.
P1F00G4.GRM The 6K TI p-Code GROM at >8000.
P1F00G5.GRM The 6K TI p-Code GROM at >A000.
P1F00G6.GRM The 6K TI p-Code GROM at >C000.
P1F00G7.GRM The 6K TI p-Code GROM at >E000.
P1F00R0.ROM The 8K TI p-Code ROM at CRU >1F00.
P1F00R1.ROM The 4K TI p-Code ROM at CRU >1F00.

P51E00R0.ROM	The 8K Myarc 512K card ROM which supports the use of Myarc Extended Basic II.
P5200R0.ROM	The 32K Speech Synthesizer ROM.
PG1100R0.ROM	The 8K Guion disk controller ROM at CRU >1100.
PG1100R1.ROM	A dummy file representing an 8K ROM.
PG1300R0.ROM	The 8K Guion RS232 Primary ROM at CRU >1300.
PG1500R0.ROM	The 8K Guion RS232 Secondary ROM at CRU >1500.
PHM3026.GRM PHM30261.GRM PHM30262.GRM PHM30263.GRM PHM30264.GRM PHM30265.GRM	TI Extended Basic command module ROMs and GROMs
PHM3052.GRM PHM30521.GRM	Tombstone City command module ROM and GROM
PHM3055.GRM	Editor/Assembler command module GROM
PM1100R0.ROM	The 8K Myarc disk controller ROM at CRU >1100.
PM1100R1.ROM	The 8K bank-switched Myarc disk controller ROM.
PM1E00R0.ROM	The 8K Myarc 512K card ROM which does not support the use of Myarc Extended Basic II.

\PC99\OLY

EDASSM.OLY	An overlay file for the Editor/Assembler.
MULTPLAN.OLY	An overlay file for Multiplan.
PC99.OLY	A copy of EDASSM.OLY, which is used as the default overlay.
TIWRITE.OLY	An overlay file for TI-Writer.

\PC99\TMP

An empty directory that is used for temporary files. The contents of the Myarc RAM disk are saved here as MYARCRD.TMP.

\PC99\UTIL

ART.EXE	A program that allows you to display TI-Artist files in DOS and save them in PCX format.
CFGGEN.EXE	A program that allows you to generate a clean PC99.CFG file for CFG.EXE.
DUMP.EXE	A program that allows you to dump a DOS file in hex and ASCII.
DUMPROM.EXE	A program that allows you dump a TI ROM file in hex to an ASCII file.
GREAD.EXE	A program that strips unwanted trailers off DOS files.
GSTRIP.EXE	A program that strips PC-Transfer or other file headers.
PATCH.EXE	A program that allows you to patch DOS files.
PMINFO.EXE	A Rational Systems program that measures the performance of protected/real-mode switching and extended memory.
RMINFO.EXE	A Rational Systems program that supplies configuration information and the basis for real/protected-mode switching on your PC.
SPCODE.EXE	A program that finds words in the Speech Synthesizer ROM and displays them as elemental components.
SPDUMP.EXE	A program that dumps the index of the Speech Synthesizer ROM.
STRIP.BAT	A batch file that uses GSTRIP.EXE to convert a disk.

6. Configuration

Once you have installed PC99, and checked the tree, you should run the configuration program, CFG.EXE. CFG.EXE allows you to display and change many variables which PC99.EXE uses. You use CFG.EXE to tell PC99, for example, which module files to load, which DOS files represent TI disks, which peripherals to load, and which VGA colors should be used to represent TI colors.

CFG.EXE is a 32-bit application, and will place the processor in protected mode.

To load CFG.EXE:

```
> c:
> cd \pc99
> cfg
```

CFG.EXE loads and displays the main menu:

```
 PC99 Config. version 4.18. 2000-apr-07

  1. RS232
  2. Sound
  3. Joysticks
  4. System
  5. Disks
  6. Keyboard
  7. Console
  8. Peripherals
  9. Module
 10. Color
 11. Status
 12. Save
 13. Defaults
 14. Test
 15. Shell
 16. Quit

 F1. Help

Select (1-16) ?
```

6.1. General information about using CFG.EXE

On all screens: Titles are displayed on the top row in color.

On most screens: You can press <F1> to get context-sensitive help.

On most screens: You can press <Esc> to go back to the previous screen.

Screens that display information usually end with:

```
Press <Enter> to continue...
```

When you press <Enter> you are returned to the previous menu.

The menu entry

```
n. Done
```

will take you back to the previous screen. The value of "n" depends on the length of the preceding menu.

All menu choices are stored in the file CFG.MNU. All menu choices for selecting a Plato disk are stored in the file CFGPLATO.MNU. The .MNU files are ASCII files and must be in the same directory that CFG.EXE is started from. While it is possible to change the wording of a line, you should not add or delete any lines from these files.

Many menus show the current selection by internal number and name. For example:

```
Sound = 0 = No sound
```

Note that the number is the internal value used by CFG.EXE, and not the value selected from the menu.

If you make changes to the PC99 configuration, you must save the changes to disk before you quit CFG.EXE.

The following sections will cover the use of each of the entries in the CFG.EXE main menu.

6.2. RS232

PC99 emulates the actions of the TMS9902 asynchronous communications controller chip and Device Service Routine (DSR) in the 8K ROM in the RS232 primary card. The RS232 primary card can be of type TI or Guion. The TI architecture also allowed an RS232 secondary card to be used.

The TMS9902 can nominally handle serial data at up to 9600 baud through two serial ports. These are designated RS232 (RS232/1) and RS232/2 on the primary card, and RS232/3 and RS232/4 on the secondary card. You use CFG.EXE to map these emulated TI ports to physical PC COM ports.

The original IBM PC design (with what came to be known as the Industry Standard Association [ISA] bus) allowed for up to eight COM ports, but only two were allocated I/O addresses — COM1 and COM2. Some third-party manufacturers of PC serial cards allowed for COM3 and even COM4, but these cards make use of addresses not supported by IBM.

Later, on IBM PS/2 machines with MicroChannel Architecture, up to 8 COM ports were allowed, but COM3 through COM8 used 16-bit addresses.

PC99 permits the use of the following standard ports:

ISA bus PC

Port	*Addr*	*IRQ*
COM1	0x3f8	4
COM2	0x2f8	3
COM3	0x3e8	4
COM4	0x2e8	3

MicroChannel PC

Port	*Addr*	*IRQ*
COM1	0x3f8	4
COM2	0x2f8	3
COM3	0x3220	3
COM4	0x3228	3
COM5	0x3320	3
COM6	0x3328	3
COM7	0x3420	3
COM8	0x3428	3

You use CFG.EXE to tell PC99 how you want the COM ports on your PC mapped. If you have a non-standard COM port, you can manually set the port address and IRQ.

At the main menu select:

```
1. RS232
```

The next menu is displayed:

```
1. Display RS232 mapping
2. Change RS232 mapping
```

6.2.1. Display RS232 mapping

A typical display is:

```
RS232/1 port = 1 = Map to PC COM1
RS232/1 addr = 0x03f8
RS232/1 irq  = 4
RS232/2 port = 0 = Map to not used
RS232/2 addr = 0x02f8
RS232/2 irq  = 3
RS232/3 port = 0 = Map to not used
RS232/3 addr = 0x03e8
RS232/3 irq  = 4
RS232/4 port = 0 = Map to not used
RS232/4 addr = 0x02e8
RS232/4 irq  = 3
PIO/1 port = 1 = Map to PC LPT1
PIO/1 addr = 0x0378
PIO/1 irq  = 7
PIO/2 port = 0 = Map to not used
PIO/2 addr = 0x0278
PIO/2 irq  = 5
```

This shows that when using PC99, any data sent to the TI emulated RS232/1 port will be sent to the PC's COM1 port. The PC's COM1 port is at PC I/O address 0x03f8, and uses PC IRQ 4.

6.2.2. Change RS232 mapping

The next menu is displayed:

```
1. Change RS232/1
2. Change RS232/2
3. Change RS232/3
4. Change RS232/4
5. Change PIO/1
6. Change PIO/2
```

If you select 1, the next menu is displayed:

```
RS232/1 port = 1 = Map to PC COM1
RS232/1 addr = 0x03F8
RS232/1 irq  = 4

1. Select PC COM port to map TI RS232/1 to
2. Select PC COM port hardware address
3. Select PC COM port hardware interrupt
```

You can now select the PC COM port, address, and interrupt to map RS232/1 to.

6.2.2.1. Select PC COM port to map TI RS232/1 to

If you select 1, the next menu is displayed:

```
RS232/1 port = 1 = Map to PC COM1

1. Map to PC COM1
2. Map to PC COM2
3. Map to PC COM3
4. Map to PC COM4
5. Map to PC COM5
6. Map to PC COM6
7. Map to PC COM7
8. Map to PC COM8
9. Map to not used
```

If you select 2, then RS232/1 will be mapped to PC COM2.

```
RS232/1 port = 2 = Map to PC COM2
```

You can map RS232/2, RS232/3 and RS232/4 in a similar way.

6.2.2.2. Select PC COM port hardware address

If you select 2, the next menu is displayed:

```
RS232/1 port = 1 = Map to PC COM1
RS232/1 addr = 0x03F8

Industry Standard Association bus (ISA)
COM1 = 0x03F8   COM2 = 0x02F8   COM3 = 0x03E8   COM4 = 0x02E8

MicroChannel Architecture (MCA)
COM1 = 0x03F8   COM2 = 0x02F8   COM3 = 0x3220   COM4 = 0x3228
COM5 = 0x4220   COM6 = 0x4228   COM7 = 0x5220   COM8 = 0x5228

Ths PC returns MicroChannel = NO

New value (hex) ?
```

The table shows the standard PC I/O addresses for COM ports. Most PCs were manufactured with ISA buses, while some IBM PCs were manufactured with MCA. CFG.EXE tests your PC and reports whether it is MCA or not. You should only use the I/O addresses appropriate to your PC.

At the prompt, you can enter any I/O address you need. Note that CFG.EXE does not validate this address.

6.2.2.3. Select PC COM port hardware interrupt

If you select 3, the next menu is displayed:

```
RS232/1 port = 1 = Map to PC COM1
RS232/1 addr = 0x03f8
RS232/1 irq  = 4

Industry Standard Association bus (ISA)
COM1 = 4   COM2 = 3   COM3 = 4   COM4 = 3

MicroChannel Architecture (MCA)
COM1 = 4   COM2 = 3   COM3 = 3   COM4 = 3
COM5 = 3   COM6 = 3   COM7 = 3   COM8 = 3

This PC returns MicroChannel = NO

New value (dec) ?
```

The table shows the standard PC Interrupt Requests (IRQs) for COM ports. Most PCs were manufactured with ISA buses, while some IBM PCs were manufactured with MCA. CFG.EXE tests your PC and reports whether it is MCA or not. You should only use the IRQs appropriate to your PC.

At the prompt, you can enter any IRQ you need. Note that CFG.EXE does not validate this value.

Notes:

1. You should only allocate a PC COM port if you have the corresponding hardware. Mapping a TI RS232 port to a non-existent COM port will fail when PC99 tries to open the port.

2. COM5 - COM8 should only be used on a MicroChannel machine.

3. You cannot have two RS232 ports use the same PC COM port. When you exit CFG.EXE you will be given a warning and the duplicated ports will be mapped to not used.

4. If you disable a TI RS232 port with CFG.EXE and then try to use that port in a 99/4A application (such as Basic), the information sent to the non-existent port will be ignored by PC99.

WARNING: Many TI applications that use the RS232 card perform a reset of both ports on the card. If you only have one COM port, PC99 will ignore any data sent to the missing port. Applications that reset the RS232 card include: Terminal Emulator 1, Terminal Emulator 2, Fast-Term and Telco.

If you do not intend to use a TI RS232 primary card (both serial and parallel), you should go to the Peripherals menu and set the peripheral type to "none". If the peripheral type is "none", any application trying to access RS232, RS232/1, RS232/2, PIO or PIO/1 will get a device error.

6.2.3. Change PIO

The TI RS232 primary card supports one parallel port, which is designated PIO (PIO/1). The TI RS232 secondary card supports PIO/2. The IBM PC allows for up to three parallel ports (LPT1, LPT2, and LPT3). For three parallel ports, the first port must be located on the Monochrome Display Adapter (MDA).

You use CFG.EXE to tell PC99 how you want the PIO ports on your PC mapped.

If you select 5, the next menu is displayed:

```
PIO/1 port = 1 = Map to PC LPT1
PIO/1 addr = 0x0378
PIO/1 irq  = 7

1. Select PC LPT port to map TI PIO/1 to
2. Select PC LPT port hardware address
3. Select PC LPT port hardware interrupt
```

6.2.3.1. Select PC LPT port to map TI PIO/1 to

If you select 1, the next menu is displayed:

```
PIO/1 port = 1 = Map to PC LPT1

1.  Map to PC LPT1
2.  Map to PC LPT2
3.  Map to PC LPT3
4.  Map to not used
```

If you select 2, then PIO/1 will be mapped to PC LPT2.

```
PIO/1 port   = 2 = Map to PC LPT2
```

You can map PIO/2 in a similar way.

6.2.3.2. Select PC LPT port hardware address

If you select 2, the next menu is displayed:

```
PIO/1 port = 1 = Map to PC LPT1
PIO/1 addr = 0x0378

New value (hex) ?
```

At the prompt, you can enter any I/O address you need. Note that CFG.EXE does not validate this address.

6.2.3.3. Select PC LPT port hardware interrupt

If you select 3, the next menu is displayed:

```
PIO/1 port = 1 = Map to PC LPT1
PIO/1 addr = 0x0378
PIO/1 irq  = 7

New value (dec) ?
```

At the prompt, you can enter any IRQ you need. Note that CFG.EXE does not validate this value.

Note: If you disable the TI PIO port with CFG.EXE and then try to use that port in a 99/4A application (such as Basic), the information sent to the non-existent port will be ignored by PC99.

If you do not intend to use a TI RS232 primary card (both serial and parallel), you should go to the Peripherals menu and set the peripheral type to "none". If the peripheral type is "none", any application trying to access RS232, RS232/1, RS232/2, PIO or PIO/1 will get a device error.

6.3. Sound

The TI-99/4A hardware supports up to three sound channels and one noise channel using the TMS9919 chip. The volume of each TI channel can be set by an application.

6.3.1. Standard PC

The PC hardware supports a single sound channel and has no volume control. It is therefore not possible to emulate faithfully TI sound using standard PC hardware.

PC99 takes any sound directed at TI sound channel 1 and reproduces it on the PC speaker. Any volume information is discarded. For example:

```
CALL SOUND (200, 880, 1)
CALL SOUND (200, 880, 8)
```

both produce the same sound on the PC speaker.

In the following example:

```
CALL SOUND (200, 30000, 1, 880, 1)
```

no sound is heard. The frequency 30000 is directed at TI sound channel 1 and is too high for humans to hear. The frequency 880 is directed at TI sound channel 2, and is ignored by PC99.

Because of this implementation, programs that use music will generally be unsatisfactory. Please note that this is a limitation of the PC hardware, not a limitation of PC99.

6.3.2. Sound Blaster

The Sound Blaster is an add-on PC card manufactured by Creative Labs. The card uses a Yamaha OPL chip which generates complex sounds using frequency modulation (FM) synthesis.

The FM synthesizer contains 18 slots (also called operators). Two slots are required for one FM channel. Under software control the nine channels can be used in three different ways:

1. nine-channel FM sound;
2. six-channel FM sound and five percussion instruments; and
3. speech synthesis.

PC99 uses the six-channel mode. PC99 plays the three TI sound channels through channels 1-3 of the Sound Blaster. PC99 plays the TI noise channel through channels 7-9 of the Sound Blaster.

Creative Labs uses different versions of the Yamaha OPL chips on different Sound Blaster models. PC99 sets all Sound Blasters to OPL2 mode. This mode permits mono, not stereo, sound reproduction.

The maximum frequency that the Sound Blaster can reproduce is 16,383Hz. This is a limitation of the Sound Blaster hardware, not a limitation of PC99.

You use CFG.EXE to tell PC99 how you want the sound on your PC configured.

At the main menu select:

```
2. Sound
```

The next menu is displayed:

```
1. Display sound setting
2. Change sound setting
3. Sound Blaster
```

6.3.3. Display sound setting

A typical display is:

```
Sound = 0 = No sound
```

This shows that when using PC99, any sound sent to the emulated TI sound chip will not be heard.

6.3.4. Change sound setting

The next menu is displayed:

```
Sound = 0 = No sound

1.  No sound
2.  One-channel sound using PC speaker
3.  Sound Blaster
4.  Sound Blaster compatible
```

If you select 2, then PC99 will start up with sound enabled. It will be one-channel sound played using the PC speaker.

If you select 3, you must have a Creative Labs Sound Blaster. CFG.EXE will make specific checks for a Sound Blaster.

Note: You will not be able to select 3. unless you have a Creative Labs Sound Blaster installed.

If you select 4, you have a sound card that the manufacturer claims is compatible with the Creative Labs Sound Blaster. CFG.EXE will not perform any checks but will address the card as if it were a Sound Blaster.

6.3.5. Sound Blaster

The next menu is displayed:

```
1.  Display Sound Blaster status
2.  Display Sound Blaster register variables
3.  Change Sound Blaster register variables
4.  Display Sound Blaster noise variables
5.  Change Sound Blaster noise variables
```

6.3.5.1. Display Sound Blaster status

This check uses software routines from the Creative Labs Sound Blaster development kit.

First a check is made for the BLASTER environment variable. If found, the I/O address, interrupt number, and DMA channel assigned are checked.

Next the FM music chip, and DSP and Voice I/O are checked.

A check is then made for the SOUND environment variable.

A typical display is:

```
FM music chip is functioning
DSP and Voice I/O are functioning
BLASTER environment variable found
Base I/O address set
Interrupt number set
DMA channel set
SOUND environment variable found
```

6.3.5.2. Display Sound Blaster register variables

The Sound Blaster contains at least one Yamaha OPL chip which is used to create complex sounds by FM synthesis. The chip has 0xF5 registers each capable of holding 8 bits of data. Not all of the registers are used by PC99. Each used register can affect the way sound is reproduced. A complete description of the function of each register is contained in the Yamaha OPL manuals.

CFG.EXE will display the contents of the registers used by PC99 in a matrix format. The register number is along the top, and the channel and slot numbers are down the side. In the Yamaha scheme, a channel is divided into a modulator and carrier, which may be set independently.

A typical display showing the 8-bit hex value of each register is:

```
Sound Blaster variables:
Type Chan Slot 0x20 0x40 0x60 0x80 0xa0 0xb0 0xc0 0xe0
Mod  01   01   b2   00   f0   fc   41   02   01   03
Mod  02   02   b2   00   f0   fc   41   02   01   03
Mod  03   03   b2   00   f0   fc   41   02   01   03
Car  01   04   b2   00   f0   fc   --   --   --   03
Car  02   05   b2   00   f0   fc   --   --   --   03
Car  03   06   b2   00   f0   fc   --   --   --   03
```

Type can be Mod(ulator) or Car(rier).
Chan is the Sound Blaster channel number (sometimes called Voice). Slot is the Sound Blaster slot number (sometimes called Operator).

Example: Register 0x62 controls the Channel 3 modulator. The register contains 0xf0. The bits in this register have the following meaning:

```
Bits          | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
              | Attack rate   | Decay rate    |
```

Note: Registers in the range 0xa0-0xc7 do not have a modulator and carrier component. The three "Car" entries in these columns of the table are not used.

6.3.5.3. Change Sound Blaster register variables

This is an interactive screen that allows you to change the register values that PC99 uses in the Sound Blaster Yamaha OPL chip. You can experiment with the sound by playing a 3-channel chord, a fixed frequency on channels 1, 2 and 3, or a selected frequency on channel 1.

If you change the register values and then save the configuration, PC99 will play sound using the register values you have chosen.

A typical display is:

```
                              0x20 0x40 0x60 0x80 0xa0 0xb0 0xc0 0xe0
Modulator ch 01, slot 01 =  b2   00   f0   fc   41   22   01   03
                              ==
          ch 02, slot 02 =  b2   00   f0   fc   d7   22   01   03

          ch 03, slot 03 =  b2   00   f0   fc   60   23   01   03

Carrier   ch 01, slot 01 =  b2   00   f0   fc   --   --   --   03

          ch 02, slot 02 =  b2   00   f0   fc   --   --   --   03

          ch 03, slot 02 =  b2   00   f0   fc   --   --   --   03

| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 |
| AM |VIB | EG |KSR |       MULTI       | = b2
```

The upper portion of the table shows the register values. For example, the values under the column 0x20 are the values in registers 0x20, 0x21, 0x22, 0x23, 0x24, and 0x25.

Note: Registers in the range 0xa0-0xc7 do not have a modulator and carrier component. The three "Car" entries in these columns of the table are not used.

The lower portion of the display shows the bit values of the current register.

You use the arrow keys to move the = = cursor to the variable you wish to change.

Press:

<a>	to change all values in a column.
<c>	to change the value pointed to by the = = cursor.
<d>	to restore PC99 defaults.
<m>	to change only the 3 modulator values.
<o>	to zero all display values.
<p>	to play sound using the register values.
<r>	to change only the 3 carrier values.
<z>	to zap any sound (reset the OPL chip).
<space>	to stop a sound.
<home>	to set the = = cursor to top left.
<end>	to set the = = cursor to bottom right.
<page up>	to increment the current register value.
<page dn>	to decrement the current register value.
<arrows>	to move the = = cursor.

Example:

Move the = = two columns to the right until it is under 0x60.

Press <c> (for change).

New value ? f1

The register value changes to f1.

Press <p> to play a sound.

Press <space> to stop the sound.

Each time you change a register you potentially change the quality of the synthesized sound. When the sound is to your liking, press <Esc> to exit this screen and then save the configuration before quitting CFG.EXE. The changed register values will be used by PC99 when it starts.

6.3.5.4. Display Sound Blaster noise variables

To play a TI noise, PC99 uses register 0xbd of the Yamaha OPL chip. Setting this register to 0x20 places the chip in Rhythm Mode. The bits of this register are used to control AM and vibrato depth, select rhythm mode, and for on/off control of rhythm instruments:

```
    7         6         5      4      3      2       1        0
AM-depth  VIB-depth  Rhythm  Bass  Snare  TomTom  TopCym   Hihat
```

Example: setting register 0xbd to 0x22 enables rhythm mode, and turns the top cymbal on.

Slots 13-18 correspond to the rhythm sounds. You need to set the appropriate registers to create rhythm sounds that approximate the noises on the TI.

A typical display showing the 8-bit hex value of each rhythm mode register is:

```
Sound Blaster noise variables:

Type Chan Slot 0x20 0x40 0x60 0x80 0xa0 0xb0 0xc0 0xe0
Mod  07   13   b2   00   f0   1f   77   03   01   00
Mod  08   14   b2   00   f0   38   00   00   00   00
Mod  09   15   b2   00   f0   f0   cc   00   00   01
Car  07   16   b2   00   f0   1f   --   --   --   00
Car  08   17   b2   00   f0   88   --   --   --   00
Car  09   18   b2   00   f0   ff   --   --   --   00
```

Type can be Mod(ulator) or Car(rier).

Chan is the Sound Blaster channel number (sometimes called Voice). Slot is the Sound Blaster slot number (sometimes called Operator).

6.3.5.5. Change Sound Blaster noise variables

This is an interactive screen that allows you to change the register values that PC99 uses in the Sound Blaster Yamaha OPL chip. You can experiment with the sound by playing rhythm sounds.

If you change the register values and then save the configuration, PC99 will play the rhythm sounds as TI noises using the register values you have chosen.

A typical display is:

```
                      0x20 0x40 0x60 0x80 0xa0 0xb0 0xc0 0xe0
Mod ch 01, slot 13 =  03   00   f0   1f   77   03   01   00   BD
                      ==
    ch 02, slot 14 =  00   00   f0   38   00   00   00   00   HH

    ch 03, slot 15 =  bf   00   f0   f0   cc   00   00   01   TOM

Car ch 01, slot 16 =  03   00   f0   1f   --   --   --   00   BD

    ch 02, slot 17 =  00   00   f0   88   --   --   --   00   SD

    ch 03, slot 18 =  0f   00   f0   ff   --   --   --   00   TC

| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | (0xbd = 20)
| AM |VIB | EG |KSR |       MULTI       | = 00
```

The upper portion of the table shows the register values. For example, the values under the column 0x20 are the values in registers 0x30, 0x31, 0x32, 0x33, 0x34, and 0x35.

Note: Registers in the range 0xa0-0xc7 do not have a modulator and carrier component. The three "Car" entries in these columns of the table are not used.

The symbols at the end of each line are:

BD	= Bass Drum
HH	= Hi hat
TOM	= Tom tom
SD	= Snare drum
TC	= Top cymbal

The lower portion of the display shows the bit values of the current register, as well as the contents of the 0xbd register.

You use the arrow keys to move the = = cursor to the variable you wish to change.

Press:

<a>	to change all values in a column.
<c>	to change the value pointed to by the = = cursor.
<d>	to restore PC99 defaults.
<m>	to change only the 3 modulator values.
<n>	to change noise values in register 0xbd.
<o>	to zero all display values.
<p>	to play sound using the register values.
<r>	to change only the 3 carrier values.
<z>	to zap any sound (reset the chip).
<space>	to stop a sound.
<home>	to set the = = cursor to top left.
<end>	to set the = = cursor to bottom right.
<page up>	to increment the current register value.
<page dn>	to decrement the current register value.
<arrows>	to move the = = cursor.

Example:

Using the default values, press <n> to change the value of register 0xbd. The current register display is changed to show the bit values in register 0xbd.

New value? 22

This enables rhythm mode, and turns the top cymbal on. The current value of register 0xbd is displayed at the end of the bit values line for the register the = = cursor is on.

Press <p> to play the rhythm sound.

Press <space> to stop the sound.

Each time you change a register you potentially change the quality of the rhythm sound. When the sound is to your liking, press <Esc> to exit this screen and then save the configuration before quitting CFG.EXE. The changed register values will be used by PC99 when it starts.

6.4. Joysticks

The TI hardware supports up to two "digital" joysticks, each of which can have one fire button.

The PC hardware supports up to two analog joysticks, each of which can have two fire buttons.

PC99 reads the PC joysticks and translates any movement within one-eighth of full calibration as true. For example, if your PC joystick calibrated a full left-to-right movement as 800 units, a full left would be 0 (zero) units and a full right would be 800 units. The center position would be 400 units. If you move the PC joystick to the left, any value less than 800/8 = 100 units (a reading of 0 through 100) is considered to be a TI joystick left. Similarly for all other directions.

Any PC joystick button is considered to be a TI fire button.

You use CFG.EXE to tell PC99 how you want the joysticks on your PC configured.

At the main menu select:

```
3. Joysticks
```

The next menu is displayed:

```
1.  Display joystick mapping
2.  Change joystick mapping
3.  Display joystick port
4.  Change joystick port
5.  Test joystick
```

6.4.1. Display joystick mapping

A typical display is:

```
Joystick 1        = 1 = Map to PC joystick port 1
Top value         = 102
Left value        = 105
Bottom value      = 714
Right value       = 735
Hardware status   = attached

Joystick 2        = 0 = Map to not used
Top value         = 0
Left value        = 0
Bottom value      = 0
Right value       = 0
Hardware status   = *** not attached ***
```

In this example, PC joystick 1 is being used as TI joystick 1.

6.4.2. Change joystick mapping

The next menu is displayed:

```
1.  Change TI Joystick 1 mapping
2.  Change TI Joystick 2 mapping
```

If you select 1, the next menu is displayed:

```
Joystick 1 = 0 = Map to not used

1.  Map to PC joystick port 1
2.  Map to PC joystick port 2
3.  Map to not used
```

If you select 1, then TI joystick 1 will be mapped to PC joystick 1.

Note: A "Map to not used" entry for a joystick will enable the PC keyboard ALT keys to emulate the TI joystick. See the keyboard section.

A mapped joystick must be calibrated. CFG.EXE will issue the warning:

```
*** Calibration values for Joystick 1 need to be set ***
```

PC joysticks generally need to be calibrated before they can be used by an application (such as PC99). Typically, an application asks for the joystick to be moved to the top/left position and then to the bottom/right position. The values returned by the joystick are then used by the application.

With CFG.EXE you normally need only calibrate your joystick once. The calibration values are stored in PC99.CFG.

Note: If you change a joystick, or alter the slide potentiometers on the joystick, you will have to calibrate the joystick again.

When you press <Enter>, the following screen is displayed:

```
1. Read new calibration values from joystick
2. Use old calibration values
3. Display old calibration values
```

6.4.2.1. Read new calibration values from joystick

The next screen is displayed:

```
Move joystick to top/left then press any joystick button

Raw values:
      Top         = 14
      Left        = 14

Press <Enter> to continue...

Move joystick to bottom/right then press any joystick button

Raw values:
      Bottom      = 614
      Right       = 670

Press <Enter> to continue...

Scaled values:
Joystick 1  = 1 = Map to PC joystick port 1
  Top             = 75
  Left            = 82
  Bottom          = 525
  Right           = 574
```

The joystick is now calibrated. You must save this configuration before exiting.

6.4.2.2. Use old calibration values

A typical display is:

```
Joystick 1  = 1 = Map to PC joystick port 1
  Top             = 75
  Left            = 82
  Bottom          = 525
  Right           = 574
```

These scaled values will be used for joystick 1 if you save the configuration. If all the old values are 0, a warning message is issued.

6.4.2.3. Display old calibration values

A typical display is:

```
Joystick 1  = 1 = Map to PC joystick port 1
  Top             = 75
  Left            = 82
  Bottom          = 525
  Right           = 574
```

This allows you to check the current scaled calibration values.

6.4.3. Display joystick port

A typical display is:

```
Joystick Port = 0 = Standard
```

In this example, PC99 will access the joysticks through the standard joystick I/O port.

6.4.4. Change joystick port

The next menu is displayed:

```
Joystick Port = 0 = Standard

1.  Standard
2.  Notebook Gameport (tm)
```

If you select 1, PC99 will access the PC joysticks through the standard joystick I/O port at 0x201.

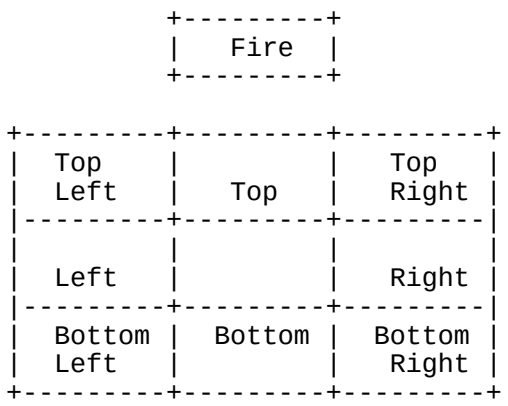
If you select 2, PC99 will access the PC joysticks through the Colorado Systems Notebook Gameport. You must have the Gameport attached and have loaded the Gameport TSR driver (NG) to select this option.

6.4.5. Test joystick

The next menu is displayed:

```
1.  Test joystick 1
2.  Test joystick 2
```

This allows you to test a calibrated joystick. Select the joystick to test from the above menu, and the following screen is displayed:



The displayed legends are in green. To test the joystick you should move it to each of the indicated positions. If the joystick movement is detected, the legend will flash red. Pressing any fire button will flash the fire legend.

6.5. System

The system section allows you to change PC99 system variables. The PC99 system variables are:

Debug mode
Aspect X offset
Aspect Y offset
Show startup info
VDP interrupt count
Delay value 1, Delay value 2
Illegal CPU action flag
Illegal VDP action flag
CPU type
VDP type
Speech quality
Gramulator emulation
Overlay file
Mini title color
Mini inactive title color
Mini label color
Mini breakpoint color
Mini value color
Mini prompt color
Mini message color
Size of instruction stack
Size of trace stack
Size of filter stack

These are explained below.

At the main menu select:

```
4.  System
```

The next menu is displayed:

```
1. Display system variables
2. Change system variables
3. Display overlay file
4. Change path of overlay file
5. Select overlay file in \pc99\oly
6. Display delay units per clock tick
```

6.5.1. Display system variables

A typical display is:

```
Debug mode                = 0 = No debug
Aspect X Offset           = 64
Aspect Y Offset           = 48
Show startup info         = NO
Interrupt count           = 2200
Delay value 1             = 0 % (no delay)
Delay value 2             = 0 % (no delay)
Illegal CPU action flag   = 1 = Ignore and continue with next instruction
Illegal VDP action flag   = 1 = Mask illegal bit and continue
CPU type                  = 1 = 9900
VDP type                  = 1 = 9918A
Speech Quality            = 1 = Standard
Gramulator Emulation Flag = 0 = NO
Overlay file              = \PC99\OLY\PC99.OLY
Mini title color          = 2 = Medium Green
Mini inactive title color = 9 = Light Red
Mini label color          = 14 = Gray
Mini breakpoint color     = 7 = Cyan
Mini value color          = 15 = White
Mini prompt color         = 3 = Light Green
Mini message warn color   = 9 = Light Red
Mini message info color   = 3 = Light Green
Size of instruction stack = 500
Size of trace stack       = 500
Size of filter stack      = 500
```

6.5.2. Change system variables

The next menu is displayed:

```
 1. Change default debug mode
 2. Change show startup info
 3. Change VDP interrupt count
 4. Change delay value 1
 5. Change delay value 2
 6. Change illegal action response
 7. Change CPU type
 8. Change VDP type
 9. Change speech quality
10. Change Gramulator emulation
11. Set up mini screen
```

You can change the Debug mode, Startup info state, VDP interrupt count, Delay values, Illegal action response, CPU type, VDP type, Speech quality, Gramulator emulation, and set up Mini-Screen values.

6.5.2.1. Change default debug mode

The next menu is displayed:

```
Debug mode = 0 = No debug

1.  No debug
2.  Peripheral status
3.  Overlay file
4.  Mini screen
5.  TI aspect ratio
```

PC99 has five debug modes:

Mode 0: PC99 displays a standard TI screen (256w x 192h) on the PC screen, with the PC video mode set to 320w x 200h. Nothing is displayed in the 64-pixel area to the right of the TI screen. This mode allows PC99 to execute at maximum speed.

Mode 1: PC99 displays a standard TI screen (256w x 192h) on the PC screen, with the PC video mode set to 320w x 200h. VDP and peripheral status information, together with the read/write state of the disks is displayed in the 64-pixel area to the right of the TI screen. When a disk is read from, a green block is displayed next to the disk number. When a disk is written to, a red block is displayed to the right of the position of the green block.

Mode 2: PC99 displays a standard TI screen (256w x 192h) on the PC screen, with the PC video mode set to 320w x 200h. The contents of the overlay file are displayed in the area to the right of the TI screen.

Mode 3: PC99 displays a mini TI screen (256w x 192h) on the PC screen, with the PC video mode set to 640w x 480h. The rest of the screen is filled with full debugging information.

Mode 4: PC99 display a standard TI screen (256w x 192h) on the PC screen, with the PC video mode set to 640 x 480. Each TI pixel is replicated four times to generate a TI display of 512w x 384h. The aspect ratio of this display closely matches the aspect ratio of the TI screen on a TI monitor.

In PC99 you access the debugger by pressing the <Esc> key at any time. The display depends on the current debugger mode.

In all debug modes the 99/4A application is suspended and PC99 displays the debugger prompt (?). In all debug modes you can press <c> to continue the application. You can also press <?> (help) to display the available commands. Most debugger commands are completed by pressing <Enter>.

The debugger section explains all the debugger commands.

If you select 2 from the Change default debug mode menu, PC99 will display VDP and peripheral status information on the right of the main screen when it starts up.

Note: If you select a mode which is not applicable to a program, Mode 0 will be used. For example, if you set the default debug mode to 4. Mini screen, and run PC99A (or PC99L) which does not support the Mini-Screen, Mode 0 will be used.

6.5.2.2. Change show startup info

The next screen is displayed. A typical sequence is:

```
Show startup info = NO

New value (0 = NO, 1 = YES) ?
```

PC99 uses DOS disk files to load appropriate areas of TI memory. For example, the file \PC99\MODULES\CON4AR0.ROM, represents the 8K console ROM loaded at TI CPU memory addresses >0000 through >1FFF. When Show startup info = YES, the name of each file loaded will be displayed, together with its type, starting address, and length. This can be useful for debugging PC99 problems.

When Show startup info = YES, the first display shows the read/write state of the disks. A typical display is:

```
DSK1 = read write
DSK2 = read write
DSK3 = read write
DSK4 = read write
```

Press <Enter>, then for each file loaded, a typical entry display is:

```
Loading: TI Memory
File = \PC99\MODULES\CON4AR0.ROM
loadtype = 0xff, loadaddress = 0x0000, datalength = 0x2000 bytes
```

Press <Enter> to load the next file. Typically 15 files are loaded, but this number could vary if you have enabled or disabled peripherals.

6.5.2.3. Change VDP interrupt count

The next screen is displayed. A typical sequence is:

```
Interrupt count = 6500
New value (100 - 65000) ?
3200
Interrupt count = 3200
```

The VDP processor on the 99/4A generates a hardware interrupt 60 times a second. (Some export models are set for 50 times a second.) In PC99 this interrupt is simulated by accumulating the time value for each TI instruction. When the accumulated value reaches 1/60 sec. PC99 sets its internal VDP interrupt flag.

This means that all events that depend on VDP timing will occur proportionally to the events on the 99/4A. In real time, the events in PC99 may occur faster or slower than a 4A depending on the speed of the PC. But, if you were to generate a counter and set a sprite moving in TI Extended Basic, then for any value of the counter the sprite will be in approximately the same position on the screen as on the 4A.

The default value for the interrupt count is 6500 TI instructions. This value is appropriate for a PC with a 90MHz Pentium processor. If you increase the value it will take longer for a VDP interrupt to occur. An application such as Multiplan, which does not generate complex graphics, will run faster with fewer VDP interrupts. However, if you do this in an application such as Parsec you will find that sprites tend to undershoot their normal positions.

You need to find a default value that suits most of your applications.

Note: For an unusual application, you can also change the interrupt count dynamically from within PC99 using the debugger.

6.5.2.4. Change delay value 1

The next screen is displayed. A typical sequence is:

```
Delay value 1             = 0 = No delay
New value (0 - 999) ?
5
Delay value 1             = 5
```

Some TI applications, especially games, may become difficult to use on a fast PC. You can slow the emulation by changing the delay value to be greater than 0.

This value is used to call the FastGraph routine fg_stall. fg_stall delays a program's execution by a given number of processor-specific delay units. This delay occurs between each emulated TI instruction.

Delay value 1 and delay value 2 are combined and the total represents the number of times fg_stall is called.

6.5.2.5. Change delay value 2

The next screen is displayed. A typical sequence is:

```
Delay value 2             = 0 = No delay
New value (0 - 999) ?
5
Delay value 2             = 5
```

Some TI applications, especially games, may become difficult to use on a fast PC. You can slow the emulation by changing the delay value to be greater than 0.

This value is used to call the FastGraph routine fg_stall. fg_stall delays a program's execution by a given number of processor-specific delay units. This delay occurs between each emulated TI instruction.

Delay value 1 and delay value 2 are combined and the total represents the number of times fg_stall is called.

6.5.2.6. Change illegal action response

The TMS9900 processor has a range of legal instructions that it can execute. The TMS9918A Video Display Processor defines certain bits to be set when setting up a VDP write address. If an application, either deliberately or accidentally, generates an illegal instruction or illegal bits for a VDP write address, the hardware tends to ignore it. However, the results can be unpredictable.

In PC99 you can choose the action to be taken when an illegal action is encountered.

The next screen is displayed:

```
1.  Change illegal CPU opcode action
2.  Change illegal VPD write address action
```

If you choose 1, the next screen is displayed:

```
1.  Ignore and continue with next instruction
2.  Display warning and then continue
3.  Halt execution
```

If PC99 encounters an illegal opcode for the current processor type, you can choose the action that will be taken. Illegal opcodes can be encountered if an assembly program incorrectly transfers control to a data area.

If you choose 2, the next screen is displayed:

```
1.  Mask illegal bit and continue
2.  Display warning, mask bit, and then continue
3.  Halt execution
```

If PC99 encounters an attempt to write an illegal value to the VDP write address of the VDP processor, you can choose the action that will be taken. Badly formed VDP write addresses can be generated by incorrect data in assembly language programs.

6.5.2.7. Change CPU type

The next screen is displayed:

```
CPU type = 1 = 9900

1.  9900
2.  9995
```

If you choose 1, the instruction set for the TMS9900 processor will be in effect.

If you choose 2, the instruction set for the TMS9995 processor will be in effect.

6.5.2.8. Change VDP type

The next screen is displayed.

```
VDP type = 1 = 9918A

1.  9918A
2.  9938
3.  9958
```

For each choice the appropriate VDP processor is emulated.

6.5.2.9. Change speech quality

The next screen is displayed:

```
Speech Quality            = 1 = Standard

  1. Standard
  2. Enhanced
```

If you choose 1 the speech quality will be equivalent to the Speech Synthesizer. If you choose 2, an improved speech algorithm that was under development will be used.

6.5.2.10. Change Gramulator emulation

The next screen is displayed:

```
Gramulator Emulation Flag = 0 = NO

  1. Enable emulation
  2. Disable emulation
```

If you choose 1, then address >FFFE is treated as the Gramulator status register.

6.5.2.11. Set up mini screen

The next menu is displayed:

```
       1. Change mini title color
       2. Change mini inactive title color
       3. Change mini label color
       4. Change mini breakpoint color
       5. Change mini value color
       6. Change mini prompt color
       7. Change mini message color
       8. Change size of instruction stack
       9. Change size of trace stack
      10. Change size of filter stack
```

If you select 1-7 you can change the colors of objects and fields on the Mini-Screen.

The title color is the color of an object title when that object is active. For example, "VDP Registers" is a title. An active object is dynamically updated. The default active color is Green.

The inactive title color is the color of an object that is inactive. For example, "Breakpoints" is a title. An inactive object is only updated when a break occurs, or <Esc> is pressed. The default inactive color is Light Red.

The label color is the color of an object label. For example, "R0", "R1", etc, are labels in the "Workspace Registers" object. The default label color is Gray.

The breakpoint color is the color of a field in the Breakpoints object when a break occurs. For example, if a Breakpoint field contains "PC =02b2", and the Program Counter gets set to >02B2, then the field will be set to this color. The default breakpoint color is Cyan.

The value color is the color of the values in an object. For example, in the "Workspace Registers" object, the label "R0" has a four-digit hex value displayed to the right. The default value color is White.

The prompt color is the color of the characters displayed on the last line of the screen.

The message color is the color of the characters displayed on the line above the last line on the screen.

If you select 1, a typical display is (blocks of color are shown above the color name):

```
Mini title color = 2 = Medium Green

 0. Transparent    1. Black          2. Medium Green   3. Light Green
 4. Dark Blue      5. Light Blue     6. Dark Red       7. Cyan
 8. Medium Red     9. Light Red     10. Dark Yellow   11. Light Yellow
12. Dark Green    13. Magenta       14. Gray          15. White

New value (0 - 15) ?
3

Mini title color = 3 = Light Green
```

Similar displays let you change the other colors.

There are three "stacks" on the Mini-Screen. These are arrays that contain the following information:

The instruction stack contains 16-bit values representing the last "n" instructions that have been executed. In the "PC Instr" object, these values are dynamically disassembled to produce the display. You can set the size from 50 to 1000 entries. When the size is exceeded, the stack is pushed, and the first entry on the stack is lost. The default size is 400 instructions.

The trace stack allows you to accumulate selected events. You can set the size from 50 to 1000. The value determines how many events are saved. When this value is exceeded, the stack is pushed, and the first entry on the stack is discarded. The default size is 400 traces.

The filter stack is a mirror of the trace stack. The trace stack only contains enabled events, while the filter stack contains all events — both enabled and disabled. You can set the size from 50 to 1000, but is should not be less than the trace stack. The value determines how many events are saved. When this value is exceeded, the stack is pushed, and the first entry on the stack is discarded. The default size is 400 traces.

If you select 6, a typical display is:

```
Size of instruction stack = 400

New value (50 - 1000) ?
500

Size of instruction stack = 500
```

The debugger section explains the use of the trace stack.

6.5.3. Display overlay file

The overlay file is an ASCII file that can be displayed to the right of the PC99 screen and can contain the equivalent of the plastic console overlay strips supplied with the 99/4A console and some modules.

The contents of the current overlay file will be displayed to the right of a simulated TI screen.

Overlay files can be displayed in PC99 by setting the debug mode to 2 (sdm 2).

6.5.4. Change path of overlay file

A typical display is:

```
Overlay file = \PC99\OLY\PC99.OLY

New path ?
```

Enter the path to the new file. Note that the only check made is whether the file exists. There are no checks made of the contents of the file.

6.5.5. Select overlay file in \pc99\oly

This presents a menu of the files in the directory \pc99\oly that have a .oly suffix. You can select the file by number, and it will become the new overlay file.

6.5.6. Creating an overlay file

You can create your own overlay files with an ASCII editor. We recommend that you store these in \PC99\OLY, with a .OLY extension. Overlay files are designed to represent the **FCTN** and **CTRL** key functions found on the plastic overlay strips supplied with the TI console and some command modules. However, you can store any information that you wish to display while PC99 is running.

PC99 expects the overlay file to be in ASCII format and contain a maximum of 25 lines. Each line in the file should be no more 10 characters wide. (The display mechanism uses a proportional font, PC99.FGF, so in some cases you can squeeze in one or more letters.) Because the font is only 5 pixels high, most characters look best in capitals.

An overlay file is displayed into a fixed area which is "clipped". If you have longer lines than will fit into the clip region, they will be truncated by pixels, not characters.

You can set the color of one or more characters by the following escape sequence:

0x7f <color value>

where <color value> is:

000	BLACK
001	BLUE
002	GREEN
003	CYAN
004	RED
005	MAGENTA
006	BROWN
007	GRAY
008	DARK_GRAY
009	LIGHT_BLUE
010	LIGHT_GREEN
011	LIGHT_CYAN
012	LIGHT_RED
013	LIGHT_MAGENTA
014	YELLOW
015	WHITE

You can key these values by pressing and holding ALT, followed by the three-digit value, and then releasing ALT. For example, to set the color to light_red:

ALT (down) 1 2 7 ALT (up)	(0x7f)
ALT (down) 0 1 2 ALT (up)	start light_red

You can also underline characters using the following escape sequence:

0x7f 0x5f

For example, to start an underscore:

ALT (down) 1 2 7 ALT (up)
_ (underscore = 0x5f)

You end an underscore using the same sequence.

6.5.7. Display delay units per clock tick

To slow down the PC99 emulation you change one of two delay values under "Change delay value {1-2}".

PC99 uses the FastGraph function fg_stall to slow the emulation.

fg_stall delays a program's execution by a given number of processor-specific delay units.

This delay occurs between each emulated TI instruction.

Delay value 1 and delay value 2 are combined and the total represents the number of times fg_stall is called.

A typical display is:

```
Delay unit for fg_stall() = 65535
```

This value is used internally by fg_stall and is proportional to the system's processor speed.

6.6. Disks

PC99 emulates the following disk controllers:

1. Texas Instruments
2. Guion
3. Myarc FDC

6.6.1. Texas Instruments Disk Controller

PC99 emulates the actions of the Western Digital WD1771 floppy disk controller and the Device Service Routine (DSR) in the TI disk controller. The DSR communicates with the disk hardware through 8 registers located at >5FF0 through >5FF8. Values placed in these registers are passed to the WD1771 chip. PC99 emulates all actions of the TI hardware.

The TI disk controller can handle up to double-sided single-density (DSSD) disks. Each disk contains 2 sides, 40 tracks/side, 9 sectors/track, and 256 bytes/sector. The amount of user data on a DSSD disk is:

2 x 40 x 9 x 256 = 184,320 bytes

The amount of user data on a track is:

9 x 256 = 2,304 bytes

When formatting a disk, the WD1771 places control information between each sector. Each disk track contains a total of 3,253 bytes of information. Of these, only 2,304 bytes are user data. A PC99 DSSD disk file therefore requires:

2 x 40 x 3253 = 260,240 bytes

This is the size of the DOS file containing the PC99 emulated disk.

The TI disk controller can handle up to three drives. To emulate these three drives, you need space on your PC hard drive for three 260,240-byte files. The default names of these files are DSK1, DSK2, and DSK3. These names are set using CFG.EXE. The files usually live in the \PC99\DSK directory.

6.6.2. Guion Disk Controller

John Guion supplied an 8K ROM and a hardware kit for the TI disk controller. This disk emulation is similar to the TI disk controller in terms of hardware emulation (disk data size, CRU addresses and register locations). The Guion DSR also allows access to four disk drives and the use of lower-case names.

6.6.3. Myarc Disk Controller (FDC)

PC99 emulates the actions of the Western Digital WD1772 floppy disk controller and the Device Service Routine (DSR) in the Myarc disk controller (FDC). The DSR communicates with the disk hardware through 8 registers located at >5FF8 through >5FFF. Values placed in these registers are passed to the WD1772 chip. PC99 emulates all actions of the Myarc FDC hardware.

The Myarc disk controller (FDC) can handle up to four double-sided double-density (DSDD) disks. Each disk contains 2 sides, 40 tracks/side, 18 sectors/track, and 256 bytes/sector. The amount of user data on a DSDD disk is:

2 x 40 x 18 x 256 = 368,640 bytes

The amount of user data on a track is:

18 x 256 = 4,608 bytes

When formatting a disk, the WD1772 places control information between each sector. Each disk track contains a total of 6,872 bytes of information. Of these, only 4,608 bytes are user data. A PC99 DSDD disk file therefore requires:

2 x 40 x 6872 = 549,760 bytes

This is the size of the DOS file containing the PC99 emulated disk.

The Myarc disk controller (FDC) can handle up to four drives. To emulate these three drives, you need space on your PC hard drive for four 549,760-byte files. The default names of these files are DSK1, DSK2, DSK3 and DSK4. These names are set using CFG.EXE. The files usually live in the \PC99\DSK directory.

You select the controller you wish to use through the Peripherals menu. With either controller, there are two ways you can work with your disk files:

6.6.4. Using CFG.EXE to change disks

If you have a TI disk file called \PC99\DSK\GAMES.DSK and you want that "disk" in emulated drive 1, then you can run CFG.EXE and in the Disks section enter the path for DSK1 as \PC99\DSK\GAMES.DSK.

When you have finished using the "disk", you run CFG.EXE again and tell it the path of another file to become DSK1.

This method exactly parallels using a floppy on the 99/4A. While the entry for DSK1 is pointing to GAMES.DSK, any reads or writes to DSK1 will be made using the GAMES.DSK file.

The disadvantage of this method is that it is a little cumbersome to run CFG.EXE and type in the new path each time you change a "disk".

6.6.5. Using DOS COPY to change disks

If you have a TI disk file called \PC99\DSK\GAMES.DSK and you want that "disk" in emulated drive 1, and the current file for DSK1 is \PC99\DSK\DSK1, then you can use DOS to replace the file:

```
> copy \pc99\dsk\games.dsk \pc99\dsk\dsk1
```

The advantage of this method is that the copy is very quick.

The danger of this method is that all TI data in the original DSK1 file is destroyed.

For many purposes, this may be all right. For example, if the last disk in drive 1 had only been read from, and you have a copy of it, then you will have lost nothing.

However, if the disk in drive 1 has been written to, and you want to preserve the data, you should first copy that disk before overwriting it. For example, if you had a disk called MYPROG.DSK:

```
> copy \pc99\dsk\myprog.dsk \pc99\dsk\dsk1
```

This destroys DSK1 and replaces it with the contents of MYPROG.DSK. Assume now you wrote a Basic program and stored it on disk 1, and now wanted to have GAMES.DSK in drive 1:

```
> copy \pc99\dsk\dsk1 \pc99\dsk\myprog.dsk
> copy \pc99\dsk\games.dsk \pc99\dsk\dsk1
```

This saves DSK1 back to MYPROG.DSK and then copies GAMES.DSK to DSK1.

6.6.6. Copying disks

You can use either or both of the above two methods to change disks. Since a "disk" is simply a DOS file, you can copy it to any other drive or directory. For example, you can copy it to a floppy or Zip drive for offline storage.

When copying a file it can be given different name. You can even copy the file to another name in the \PC99\DSK directory. It is recommended that you use .DSK as the DOS filename extension. This will allow you to distinguish TI disk files from other PC files.

When PC99 is running, you can use the debugger to change the DOS file being used for a TI disk. This is explained in the debugger section.

IMPORTANT: If you erase, or accidentally overwrite one of these files in DOS, your TI data will be destroyed. You may be able to recover the file using DOS's UNDELETE command.

You use CFG.EXE to tell PC99 what DOS files to use to emulate the disks that would be in physical TI drives 1, 2, 3, and 4. Although you can give them any valid DOS name, we recommend that you name them DSK1, DSK2, DSK3 and DSK4. Each file contains the data that would be stored on a physical TI disk.

At the main menu select:

```
5. Disks
```

The next menu is displayed:

```
1.  Display disk paths
2.  Change disk paths
3.  Change disk attached flags
4.  Change disk read/write flags
5.  Display disk catalog
6.  Select Plato disk
7.  Display cassette paths
8.  Change cassette paths
```

6.6.7. Display disk paths

A typical display is:

```
DSK1     = \PC99\DSK\DSK1
Path     = good
Size     = 260240 bytes = good
Attached = YES
R/W Flag = read write
DSK2     = \PC99\DSK\DSK2
Path     = good
Size     = 260240 bytes = good
Attached = YES
R/W Flag = read write
DSK3      = \PC99\DSK\DSK3
Path      = good
Size      = 260240 bytes = good
Attached = YES
R/W Flag = read write
DSK4     = \PC99\DSK\DSK4
Path     = good
Size     = 549760 bytes = *** bad ***
Attached = YES
R/W Flag = read write
```

In this example PC99 is set up to use a TI controller. The TI controller can neither access DSK4, nor deal with a DSDD disk file, so it is flagged "bad". With a TI controller this is a legal configuration, and no warnings are generated when the configuration is saved to disk.

6.6.8. Change disk paths

The next menu is displayed:

```
1.  Change path for DSK1
2.  Change path for DSK2
3.  Change path for DSK3
4.  Change path for DSK4
5.  Display \PC99\DSK directory
```

6.6.8.1. Change path for DSK1

```
Current DSK1:
DSK1     = \PC99\DSK\DSK1
Path     = good
Size     = 260240 bytes = good
R/W Flag = read write

New path ?
```

You should enter the DOS path to the TI disk file. If either the path, or the size of the file is wrong, the path will not be changed. However, it is permissible to set up a Myarc formatted DSDD using a TI disk controller. This is analogous to placing a physical DSDD diskette in a drive connected to a TI disk controller. You may do this physically, but the controller will not be able to use the disk. In this case, CFG.EXE will warn you with:

```
*** WARNING: Using DSDD disk file with TI controller ***
```

Similar screens are displayed for DSK2-DSK4.

6.6.8.2. Display \PC99\DSK directory

This displays all files in the \PC99\DSK directory and sub-directories as an aid to finding the filename of the .DSK file you wish to use.

6.6.9. Change disk attached flags

The next menu is displayed:

```
1.  Change attached flag for DSK1
2.  Change attached flag for DSK2
3.  Change attached flag for DSK3
4.  Change attached flag for DSK4
```

If you select 1, the next menu is displayed:

```
Attached = YES

1.  Attached = YES
2.  Attached = NO
```

If a disk is set to "Attached = YES" it is the equivalent of having a TI physical drive connected to the disk controller.

If a disk is set to "Attached = NO" it is the equivalent of having no drive.

If you set a disk to be "Attached = NO" and then try to read or write to that disk in PC99, you will get a standard I/O error.

6.6.10. Change disk read/write flags

The next menu is displayed:

```
1.  Change read/write flag for DSK1
2.  Change read/write flag for DSK2
3.  Change read/write flag for DSK3
4.  Change read/write flag for DSK4
```

If you select 1, the next menu is displayed:

```
RW/Flag = read write

1.  Read Write
2.  Read Only
```

If a disk is set to "read write" it is the equivalent of using a TI diskette that does not have a write-protect tab covering the slot.

If a disk is set to "read only" it is the equivalent of using a TI diskette that has a write-protect tab covering the slot.

If you set a disk to be "read only" and then try to write to that disk in PC99, you will get a standard I/O error.

In addition, if you set the DOS file permissions on a PC99 disk file to read only, PC99 will set the "operating system read/write" flag for that disk when it starts up.

6.6.11. Display disk catalog

The next menu is displayed:

```
1.  DSK1
2.  DSK2
3.  DSK3
4.  DSK4
```

If you select 1, the next menu is displayed:

```
1.  Sector 0 information
2.  Disk Manager catalog
3.  Disk Manager catalog files only
4.  p-Code catalog
5.  Plato catalog
```

Note: Selections from this menu work by "exec'ing" the program \PC99\DSKUTIL\DSKDIR.EXE from within CFG.EXE. If this program is not in this location, the exec will fail. DOS will report "Bad command or file name".

6.6.11.1. Sector 0 information

A typical display is:

```
Disk name               = INSCEBOT
Sectors total           = 720
Sectors used            = 691
Sectors available       = 27
Sectors/track           = 9
Disk formatted (DSK)    = yes
Disk Manager protection = no
Tracks per side         = 40
Number of sides         = 2
Density                 = single
```

6.6.11.2. Disk Manager catalog

A typical display is:

```
No. FDR  Filename   Size Type        P
--- ---- ---------- ---- ---------- -
001 >002 @NEWPATH      8 PROGRAM    Y >022 007
002 >018 ARC33_1       33 PROGRAM      >1bb 032
003 >003 ARTIST        15 DIS/FIX 80   >029 014
004 >004 ARTIST1       28 PROGRAM    Y >037 027
005 >005 ARTLOAD        2 PROGRAM    Y >052 001
006 >006 ARTPT1        10 PROGRAM    Y >053 009
007 >007 ARTPT2        10 PROGRAM    Y >05c 009
008 >008 ARTPT3        33 PROGRAM    Y >065 032
009 >009 ARTPT4        31 PROGRAM    Y >085 030
010 >00a ASSM1         33 PROGRAM      >0a3 032
011 >00b ASSM2         20 PROGRAM      >0c3 019
012 >019 DISKAID_1      2 PROGRAM      >1db 001
013 >01a DISKAID_2     33 PROGRAM      >1dc 032
014 >01b DISKAID_3     20 PROGRAM      >1fc 019
015 >01c DISKASSM_1     2 PROGRAM      >20f 001
016 >01d DISKASSM_2     2 PROGRAM      >210 001
017 >01e DISKASSM_3     2 PROGRAM      >211 001
018 >01f DISKASSM_4    33 PROGRAM      >212 032
019 >020 DISKASSM_5    18 PROGRAM      >232 017
020 >00c EDIT1         25 PROGRAM      >0d6 024
021 >00d EDITA1        33 PROGRAM      >0ee 032
022 >00e EDITA2         6 PROGRAM      >10e 005

Press <Enter> to continue...

023 >00f ENHPT1         9 PROGRAM    Y >113 008
024 >010 ENHPT2        33 PROGRAM    Y >11b 032
025 >011 ENHPT3        27 PROGRAM    Y >13b 026
026 >012 EXTDSR         5 DIS/FIX 80 Y >155 004
027 >013 FORMA1        33 PROGRAM      >159 032
028 >014 FORMA2        15 PROGRAM      >179 014
029 >1c1 IDENTIFILE    33 PROGRAM      >27f 032
030 >19a IDENTIFILF    22 PROGRAM      >2a0 021
031 >015 JOYST          5 DIS/FIX 80 Y >187 004
032 >1c5 LINES_O       14 DIS/FIX 80   >271 013
033 >021 LINES_S       46 DIS/VAR 80   >243 045
034 >016 LOGO_C        25 PROGRAM    Y >18b 024
035 >017 LOGO_P        25 PROGRAM    Y >1a3 024
```

No. The sequential number of the file on the disk

FDR The sector number of the File Descriptor Record in hex.

Filename	The filename, up to 10 characters. Any non-ASCII characters are replaced by a period.
Size	The number of sectors the file occupies, in decimal.
Type	Files can be PROGRAM, or a combination of INTERNAL or DISPLAY, and FIXED or VARIABLE. For INTERNAL or DISPLAY files the record size follows.
P	A "Y" (Yes) means the file has Disk Manager protection.

Following the entry is the file fracture map. The first value is the sector number in hex. The second value is the number of sectors in decimal. The fracture map can contain a maximum of 78 entries. If the file only has an FDR, the entry will be: "No data sectors in file". Some vendors use dummy files as part of copy protection.

6.6.11.3. Disk Manager catalog files only

This displays a list of the filenames on the disk in TI sorted order.

6.6.11.4. p-Code catalog

If you catalog a p-System disk with the Disk Manager it will contain a single file called PASCAL that occupies the entire disk. This information is contained in sectors 0, 1 and 2.

When the disk is Z(ero'ed using the p-System Filer the p-System catalog is created.

If you have a p-System disk you can catalog the p-System files. A typical display is:

```
p-System disk name  = PAS5
p-System file count = 9
SYSTEM.FILER        034 13-Mar-81  >00a  >02b
SYSTEM.EDITOR       045 06-Nov-81  >02c  >058
SYSTEM.PASCAL       006 20-Oct-81  >059  >05e
SYSTEM.SYNTAX       014 12-Jan-82  >05f  >06c
SYSTEM.COMPILER     099 27-Apr-82  >06d  >0cf
SCREENOPS.CODE      012 02-Jun-81  >0d0  >0db
COMMANDIO.CODE      008 02-Jun-81  >0dc  >0e3
SYSTEM.LIBRARY      034 06-May-82  >0e4  >105
SYSTEM.CHARAC       002 14-Jan-82  >106  >107
```

The first value to the right of the date is the starting sector number in hex. The second value is the ending sector number in hex.

6.6.11.5. Plato catalog

If you catalog a Plato disk with the TI Disk Manager, a typical display is:

```
No. FDR  Filename   Size Type       P
--- ---- ---------- ---- ---------- -
001 >002 $$1           7 DIS/FIX 80   >022 006
```

This is due to the protection scheme TI uses on Plato disks. You can catalog all of the files on a Plato disk, including the hidden files. A typical display is:

```
No. FDR  Filename   Size Type       P
--- ---- ---------- ---- ---------- -
001 >002 $$1           7 DIS/FIX 80   >022 006
002 >006 DISKMENU     12 INT/FIX 64   >0de 011
003 >003 TBG1C11     148 INT/FIX 64   >028 147
004 >004 TGDP111      36 INT/FIX 64   >0bb 032 >0e9 003
005 >005 TIMENU        4 INT/FIX 64   >0db 003
```

6.6.12. Select Plato disk

This selection requires the following:

- The file CFGPLATO.MNU must be in the directory that CFG.EXE was started from.
- The directory \PC99\DSK\PLATO must exist.
- Plato disks must be stored in \PC99\DSK\PLATO in executable archive format.
- The Plato disks must match the TI numbering scheme exactly.

The TI Plato disks were released under serial numbers PHD5201 through PHD5308 and comprised 508 disks. The disks are classified by curriculum, by subject, by package, and by disk.

Under PC99, you would require at least 508 x 260,240 = 132,201,920 bytes of space (132Mb) on your hard drive to store all Plato disks. To avoid this, CFG.EXE allows you to store your Plato disks in compressed format, and then select the disk you wish to run. Using the public domain PC archive program lharc, you can reduce the amount of required disk storage to about 11Mb.

The compressed format file must be an executable archive named PHDnnnn.EXE containing all disks in a Plato package. The archive file must live in \PC99\DSK\PLATO. When executed, the file should explode and create PC99 .DSK files. The file CFGPLATO.MNU contains the mapping used by CFG.EXE to find a selected Plato disk.

When you select a Plato disk, CFG.EXE copies the corresponding PHDnnnn.EXE file to \PC99\TMP. This directory was created when you installed PC99, and must exist. CFG.EXE then explodes the compressed

file and copies the selected disk (.DSK file) to DSK1, since the Plato module requires the disk in drive 1. Finally, CFG.EXE erases the files it used in the temporary directory.

Note: You need the Plato Interpreter command module (PHM3122) to run Plato disks.

6.6.12.1. Creating compressed Plato disks

For this example, assume you want to convert the TI package PHD 5206, Subtraction skills, for use with CFG.EXE. This package consists of 5 disks:

1. Subtraction skills 1 tutorial
   Subtraction skills 1 drill
2. Subtraction skills 2 tutorial
   Subtraction skills 2 drill
3. Subtraction skills 3 tutorial
   Subtraction skills 3 drill
4. Subtraction skills 4 tutorial
   Subtraction skills 4 drill
5. Subtraction review drill
   Subtraction applications application

You must transfer the five disks from a TI system to your PC. The PC files must be named:

PHD52061.DSK
PHD52062.DSK
PHD52063.DSK
PHD52064.DSK
PHD52065.DSK

Assume these files are in \tmp. Compress these files and make an executable archive using lharc:

```
> c:
> cd \tmp
> lha a phd5206 phd5206?.dsk
```

This creates the compressed archive file PHD5206.LZH. Convert the .LZH file to an executable archive:

```
> lha s phd5206
```

This creates the file PHD5206.EXE. Move this file to \pc99\dsk\plato:

```
> move phd5206.exe \pc99\dsk\plato
```

You can now remove the .DSK and .LZH files in \tmp and use CFG.EXE to select a disk from this package.

Note: If you only have a few Plato disks you do not have to compress them and use CFG.EXE to select them. As with any other disk, you can use DOS to copy it to DSK1, or use CFG.EXE to point DSK1 to the Plato disk.

Note: You do not have to use lharc to compress the disks. However, the compressed disks must be in executable archive form — executing PHDnnnn.EXE at the DOS prompt must self-extract the .DSK files. Other archive programs, such as pkzip, are capable of producing this format.

6.6.13. Display cassette paths

A typical display is:

```
CS1     = \PC99\DSK\CS1
CS2     = \PC99\DSK\CS2
```

In the above example, if you write to the CS1 device in PC99, the data will be stored in the file \pc99\dsk\cs1.

6.6.14. Change cassette paths

The next menu is displayed:

```
1.  Change path for CS1
2.  Change path for CS2
```

6.6.14.1. Change path for CS1

When using the cassette routine built into the TI console, this file is used to store data for cassette port 1. As with disk files you should copy this file if you want to preserve its contents.

A typical display is:

```
Current CS1:
CS1 = \PC99\DSK\CS1

New path ?
```

The new path must be valid.

A similar screen is displayed for CS2.

6.6.15. The blank disks — FMT21.DSK and FMT22.DSK

During installation of PC99, the two files FMT21.DSK and FMT22.DSK are stored in \PC99\DSK. These files represent blank, formatted TI DSSD and DSDD floppy disks. You may copy the appropriate file to DSK1, DSK2, DSK3 or DSK4 to start a new disk.

You could also format a TI disk by using a program such as Disk Manager 2, DM-1000 or the Myarc Disk Manager. However, it is much quicker to copy either FMT21.DSK or FMT22.DSK in DOS. If you do format an emulated disk, note that you cannot hurt the DOS file system. PC99 only reads from or writes to the named disk files in PC99.CFG. Even a format is just a series of reads and writes into these files.

IMPORTANT: You must copy your DSK1, DSK2, DSK3 or DSK4 file to another DOS filename before formatting if you don't want to lose the data on the disk.

6.6.16. The blank disks — PFMT21.DSK and PFMT22.DSK

During installation of PC99, the files PFMT21.DSK and PFMT22.DSK are stored in \PC99\DSK. These files represent blank, formatted TI DSSD and DSDD floppy disks that have been Z(ero'ed for use with the p-System. You may copy the appropriate file to DSK1, DSK2, or DSK3 to start a new p-System disk.

You could also format a TI disk by using a program such as Disk Manager 2 or DM-1000. You could also use DFORMAT from within the p-System.

Note: If you use either DFORMAT or Z(ero, the number of p-System blocks is 360 for the DSSD emulated disk and 720 for the DSDD emulated disk.

You could then run the F)iler and Z(ero the disk. However, it is much quicker to copy PFMT21.DSK or PFMT22.DSK in DOS. If you do format an emulated disk and then Z(ero it, note that you cannot hurt the DOS file system. PC99 only reads from or writes to the named disk files in PC99.CFG. Even a format and a Z(ero is just a series of reads and writes into these files.

IMPORTANT: You must copy your DSK1, DSK2, or DSK3 file to another DOS filename before formatting or Z(ero'ing if you don't want to lose the data on the disk.

6.6.17. TI or Guion vs. Myarc disk controller

PC99 allows for the following combinations:

1. A disk written to by the TI or Guion controller will have a size of 260,240 bytes. This disk can be SSSD or DSSD. This disk can be read and written by the Myarc controller.

2. A disk written to by the Myarc controller can have a size of 260,240 or 549,760 bytes. In the first case the disk can be SSSD or DSSD. In the second case the disk can be SSSD, DSSD, or DSDD.

3. If a Myarc disk is SSSD or DSSD, it can used with the TI or Guion controller. If the Myarc disk is 549,760 bytes, only 260,240 bytes of this file will be used.

4. If a Myarc disk is DSDD, it cannot be used with the TI or Guion controller.

5. If a TI or Guion 260,240-byte disk is addressed in DSDD format by the Myarc controller, and the controller reads or writes beyond sector 719 (end of DSSD), then the file will be expanded to 549,760 bytes by PC99 on the fly. For example, if you use the Myarc Disk Manager to format a DSSD 260,240-byte file, the new file will be 549,760 bytes and be DSDD.

6. SSDD should not be used with any controller.

It would have been easiest to supply a utility that would convert all your 260,240-byte dsk files to 549,760-byte dsk files. However, this was deemed unacceptable to most users because of the large amount of disk space required.

The above situation is a compromise, and must be handled with care, but it is believed to represent the best trade-off between ease of use and disk space. The Myarc Disk Controller offers many more features than the TI and Guion controllers, so it is recommended that you use the Myarc controller for all normal operations.

Information about the Myarc Disk Manager Level III Supreme is contained in the file MYDMDOC.PDF (Acrobat) or MYDMDOC.TXT (ASCII).

6.7. Keyboard

PC99 uses the PC ROM BIOS to decode the keyboard. The BIOS does not return a value for every PC key combination. For example, the BIOS does not return a value for <Alt-5> or <Ctrl-5> on the numeric keypad. In addition, there are certain keys that have reserved values. For example, <Ctrl-C> is usually used to signal a break to a running program.

Where possible, all TI keys have been mapped to the most logical PC key. The PC ALT key is used for the TI **FCTN** key. In addition, the PC numbered function keys have been directly mapped. For example, if you need a TI **REDO (FCTN 8)**, you can simply press the PC <F8>.

Note: PC99 does not use the <F11> and <F12> keys.

6.7.1. Joystick keys

If you do not have a PC joystick, the TI joystick keys are mapped to:

Joystick 1 left	<Alt-F1>
Joystick 1 right	<Alt-F2>
Joystick 1 up	<Alt-F3>
Joystick 1 down	<Alt-F4>
Joystick 1 fire	<Alt-F5>
Joystick 2 left	<Alt-F6>
Joystick 2 right	<Alt-F7>
Joystick 2 up	<Alt-F8>
Joystick 2 down	<Alt-F9>
Joystick 2 fire	<Alt-F10>

An additional set of joystick mappings is provided for games (for example, Atari's Shamus) in which the movement and fire CRU lines are read directly:

Joystick 1 left + fire	<Ctrl-F1>
Joystick 1 right + fire	<Ctrl-F2>
Joystick 1 up + fire	<Ctrl-F3>
Joystick 1 down + fire	<Ctrl-F4>
Joystick 1 fire	<Ctrl-F5>
Joystick 2 left + fire	<Ctrl-F6>
Joystick 2 right + fire	<Ctrl-F7>
Joystick 2 up + fire	<Ctrl-F8>
Joystick 2 down + fire	<Ctrl-F9>
Joystick 2 fire	<Ctrl-F10>

If you have a PC joystick connected and you have enabled it with CFG.EXE, the mapped joystick keys are disabled.

6.7.2. Special keys.

You can make use of a standard PC feature to input certain keystrokes not detected by the BIOS. You press and hold the <Alt> key, enter a three-digit sequence on the numeric keypad, and then release the <Alt> key.

For this release the following combinations are recognized:

<Alt> 1-2-9	<Esc> (0x1b)
<Alt> 1-3-0	<Ctrl-1>
<Alt> 1-3-1	<Ctrl-2>
<Alt> 1-3-2	<Ctrl-3>
<Alt> 1-3-3	<Ctrl-4>
<Alt> 1-3-4	<Ctrl-5>
<Alt> 1-3-5	<Ctrl-6>
<Alt> 1-3-6	<Ctrl-7>
<Alt> 1-3-7	<Ctrl-8>
<Alt> 1-3-8	<Ctrl-9>
<Alt> 1-3-9	<Ctrl-0>
<Alt> 1-4-0	<Ctrl-=> (used in Funnelweb)

For the p-System:

<Ctrl-End>	CTRL . (Esc)
<Ctrl-C>	CTRL C (ETX)

You use CFG.EXE to tell PC99 what DOS file to use to emulate the TI keyboard. The file PC994A.KEY is used if you are emulating the TI-99/4A. An optional file, PC994.KEY, is available if you have purchased the 99/4 ROMs and are emulating the TI-99/4.

PC994A.KEY is an internal format file that controls the mapping between PC keys and TI-99/4A keys. You would only edit this entry in CFG.EXE if you moved the keyboard file to another directory or renamed the file.

At the main menu select:

```
6. Keyboard
```

The next menu is displayed:

```
1.  Display path of keyboard file
2.  Change path of keyboard file
3.  Display key age value
4.  Change key age value
```

6.7.3. Display path of keyboard file.

A typical display is:

```
Keyboard file     = \PC99\PC994A.KEY
Path              = good
Size              = 2349 bytes = good
```

6.7.4. Change path of keyboard file.

The next screen is displayed:

```
Current path:
\PC99\PC994A.KEY

New path ?
```

You should enter the DOS path to the TI keyboard file. If either the path, or the size of the file is wrong, the path will not be changed.

6.7.5. Display key age value.

When a key is pressed on the TI keyboard, corresponding CRU lines are raised. When the key is released, the CRU lines return to their normal state. It is up to a TI application to "catch" the keystroke while the key is pressed.

On the PC, key presses are stored in a 15-byte circular buffer. It is up to an application to retrieve the key presses from the buffer, and advance the buffer pointer to point to the next key press.

To emulate the TI keyboard, PC99 detects that a PC key has been pressed. It retrieves the key from the PC keyboard buffer and then raises the corresponding emulated TI CRU lines. A counter is then loaded with a value and PC99 begins to count down. When the count reaches zero the CRU lines are returned to their normal state. PC99 will then fetch the next key press from the PC keyboard buffer.

The value that is loaded into the counter is the key age value. By default, this is set so that the PC keyboard responds as closely as possible to a TI keyboard. Depending on the speed of your PC, and on the TI application you are running, you may wish to change the default value.

When running PC99, you can also change the key age value using the debugger.

To display the default key age value:

```
3.  Display key age value
```

The next screen is displayed:

```
Current value = 1500
```

6.7.6. Change key age value.

To change the default key age value:

```
4.  Change key age value
```

The next screen is displayed. A typical sequence is:

```
Current value = 1500
New value (0 - 5000) ? 1750
New value = 1750
```

6.8. Console

The TI-99/4A console contains one 8K ROM and three 6K GROMs. The contents of the console ROM and GROMs are stored in four DOS files. When PC99 starts up it reads PC99.CFG to find out which files to load for the console ROMs and GROMs.

You use CFG.EXE to tell PC99 which DOS files to use to emulate the TI console.

At the main menu select:

```
7. Console
```

The next menu is displayed:

```
1.  Display paths for console ROM and GROMs
2.  Change paths for console ROM and GROMs
3.  Configure 99/4A console ROM and GROMs
4.  Configure 99/4A v2.2 console ROM and GROMs
5.  Configure 99/4 console ROM and GROMs
6.  Configure OPA SOB console ROM and GROMs
7.  Configure CDC console ROM and GROMs
```

6.8.1. Display paths for console ROM and GROMs

A typical display is:

```
        Load type   Len   Addr  File
ROM   = ff = RAM 0  2000  0     \PC99\MODULES\CON4AR0.ROM
Path  = good
Size  = 8198 bytes = good

        Load type   Len   Addr  File
GROM0 = 01 = GRM 0  1800  0     \PC99\MODULES\CON4AG0.GRM
Path  = good
Size  = 6150 bytes = good

        Load type   Len   Addr  File
GROM1 = 02 = GRM 1  1800  2000  \PC99\MODULES\CON4AG1.GRM
Path  = good
Size  = 6150 bytes = good

        Load type   Len   Addr  File
GROM2 = 03 = GRM 2  1800  4000  \PC99\MODULES\CON4AG2.GRM
Path  = good
Size  = 6150 bytes = good
```

\PC99\MODULES\CON4AR0.ROM is the 8K console ROM. The file has a load type of >ff, which means it loads into RAM 0. The file has a length of >2000 bytes. The file will be loaded starting at CPU RAM >0000.

\PC99\MODULES\CON4AG0.GRM, \PC99\MODULES\CON4AG1.GRM and \PC99\MODULES\CON4AG2.GRM are the 6K console GROMs 0, 1 and 2 loaded at GROM addresses >0000, >2000 and >4000 respectively.

6.8.2. Change paths for console ROM and GROMs

The next menu is displayed:

```
1. Change path for ROM
2. Change path for GROM0
3. Change path for GROM1
4. Change path for GROM2
5. Change console type
```

If you select 1:

```
        Load type   Len   Addr  File
ROM   = ff = RAM 0  2000  0     \PC99\MODULES\CON4AR0.ROM
Path  = good
Size  = 8198 bytes = good

New path ?
```

You should enter the DOS path to the TI console ROM file. If either the path, or the size of the file is wrong, the path will not be changed.

If you select 5:

```
Type     = 1 = 99/4A

  1. 99/4A
  2. 99/4A v2.2
  3. 99/4
  4. OPA
  5. CDC
  6. User
```

You can change the console type to match the ROM/GROMs you have changed. If you select a "standard" type (99/4A, 99/4A v2.2, 99/4, OPA, or CDC) you should match the type to the correct ROM/GROMs. If you are using your own ROM/GROMs, you should set the type to user.

6.8.3. Configure 99/4A console ROM and GROMs

A typical display is:

```
Checking ROM: \PC99\MODULES\CON4AR0.ROM
Checking GROM0: \PC99\MODULES\CON4AG0.GRM
Checking GROM1: \PC99\MODULES\CON4AG1.GRM
Checking GROM2: \PC99\MODULES\CON4AG2.GRM
Checking keyboard: \PC99\PC994A.KEY

Type     = 1 = 99/4A
```

This changes the paths for the console ROM and GROMs, as well as the keyboard file for the 99/4A.

If any path or file size is wrong, the path will not be changed.

6.8.4. Configure 99/4A v2.2 console ROM and GROMs

A typical display is:

```
Checking ROM: \PC99\MODULES\CON22R0.ROM
Checking GROM 0: \PC99\MODULES\CON22G0.GRM
Checking GROM 1: \PC99\MODULES\CON22G1.GRM
Checking GROM 2: \PC99\MODULES\CON22G2.GRM
Checking keyboard: \PC99\PC994A.KEY

Type     = 2 = 99/4A v2.2
```

This changes the paths for the console ROM and GROMs, as well as the keyboard file for the 99/4A.

If any path or file size is wrong, the path will not be changed.

6.8.5. Configure 99/4 console ROM and GROMs

```
Checking ROM: \PC99\MODULES\CON4R0.ROM
Checking GROM0: \PC99\MODULES\CON4G0.GRM
Checking GROM1: \PC99\MODULES\CON4G1.GRM
Checking GROM2: \PC99\MODULES\CON4G2.GRM
Checking keyboard: \PC99\PC994.KEY

Type     = 3 = 99/4
```

This changes the paths for the console ROM and GROMs, as well as the keyboard file for the 99/4.

If any path or file size is wrong, the path will not be changed.

6.8.6. Configure OPA SOB console ROM and GROMs

```
Checking ROM: \PC99\MODULES\CONOPAR0.ROM
Checking GROM0: \PC99\MODULES\CONOPAG0.GRM
Checking GROM1: \PC99\MODULES\CONOPAG1.GRM
Checking GROM2: \PC99\MODULES\CONOPAG2.GRM
Checking keyboard: \PC99\PC994A.KEY

Type     = 4 = OPA
```

This changes the paths for the console ROM and GROMs, as well as the keyboard file for the Oasis Pensive Abacutors Son of a Board ROMs and GROMs, as well as the keyboard file for the 99/4A.

If any path or file size is wrong, the path will not be changed.

6.8.7. Configure CDC console ROM and GROMs

```
Checking ROM: \PC99\MODULES\CON4AR0.ROM
Checking GROM0: \PC99\MODULES\CONCDCG0.GRM
Checking GROM1: \PC99\MODULES\CON4AG1.GRM
Checking GROM2: \PC99\MODULES\CON4AG2.GRM
Checking keyboard: \PC99\PC994A.KEY

Type     = 5 = CDC
```

This changes the paths for the console ROM and GROMs, as well as the keyboard file for the Control Data Corporation (CDC) ROMs and GROMs, as well as the keyboard file for the 99/4A. The CDC console was the same as the 99/4A console, except for GROM 0.

If any path or file size is wrong, the path will not be changed.

6.9. Peripherals

TI peripherals, such as the disk controller and RS232 card, usually contain an 8K ROM. This ROM is "paged" into the address space >4000->5FFF by CRU commands. The ROM contains, at an absolute minimum, a DSR for applications to communicate with the peripheral.

PC99 provides for the following peripherals:

Disk Controller card

TI:	8K ROM. CRU >1100
Guion:	8K ROM. CRU >1100
Myarc:	8K bank-switched ROM, and a 4K ROM. CRU >1100.

RS232 primary and secondary cards

TI:	8K ROM. CRU >1300 (primary), >1500 (secondary).
Guion:	8K ROM. CRU >1300 (primary), >1500 (secondary).

Thermal Printer

TI:	8K ROM. CRU >1800.

PC99 card

PC99:	8K ROM. CRU >1B00.

Memory card

TI:	No ROM. No CRU.
Myarc:	8K ROM. CRU >1000.
AMS:	No ROM. CRU >1E00.

p-Code card

TI:	8K bank-switched ROM, a 4K ROM and eight 6K GROMs. On power-up the p-Code card takes control and boots the p-System. CRU >1F00.

Speech Synthesizer

TI:	32K ROM. No CRU.

You use CFG.EXE to tell PC99 which DOS files contain the ROMs (if any) in these peripherals, and which of these peripherals is enabled.

Note: If there is more than one option for a peripheral, only one can be selected. For example, you can only have one disk controller active, either TI or Myarc, but not both.

At the main menu select:

```
8. Peripherals
```

The next menu is displayed:

```
1.  Display peripheral ROMs and GROMs
2.  Change peripheral ROMs and GROMs
3.  Display peripheral type
4.  Change peripheral type
5.  Setup peripheral
```

6.9.1. Display peripheral ROMs and GROMs

The next menu is displayed:

```
1.  Disk Controller card
2.  RS232 primary card
3.  RS232 secondary card
4.  Thermal Printer
5.  PC99 card
6.  Memory card
7.  p-Code card
8.  Speech Synthesizer
```

If you select 1:

```
Disk Controller:
Type  = 1 = Texas Instruments
CRU   = >1100
        Load type   Len   Addr  File
ROM 0 = ff = RAM 0  2000  4000  \PC99\MODULES\P1100R0.ROM
Path  = good
Size  = 8198 bytes = good
        Load type   Len   Addr  File
ROM 1 = 1c = DCR 1  1000  4000  \PC99\MODULES\P1100R1.ROM
Path  = good
Size  = 4102 bytes = good
```

Type "= 1 = Texas Instruments" means TI DC (DSSD). Other possible types are Guion, Myarc and CorComp.

IMPORTANT: if a peripheral type is set to "none", it is the equivalent of removing that peripheral from the p-Box.

CRU — This peripheral is based at CRU >1100.

ROM 0 — The file has a load type of >FF, which means it loads into RAM 0. The data length is >2000 bytes and the load address in CPU memory is >4000. The file to be loaded is \PC99\MODULES\P1100R0.ROM.

Path — "= good" means that the file can be accessed.

Size — A ROM 0 file should be 8198 bytes (good).

ROM 1 — The file has a load type of >1C, which means it loads into DCR 1 (disk controller ROM). The data length is >1000 bytes and the load address in CPU memory is >4000. The file to be loaded is \PC99\MODULES\P1100R1.ROM. *Note*: This 4K ROM area is reserved for disk controllers that have a bank-switched ROM, such as the Myarc Disk Controller. It is not used by the TI or Guion disk controller.

Path — "= good" means that the file can be accessed.

Size — A ROM 1 file (bank-switched) should be 4102 bytes (good).

6.9.2. Change peripheral ROMs and GROMs

The next menu is displayed:

```
1.  Disk Controller card
2.  RS232 primary card
3.  RS232 secondary card
4.  Thermal Printer
5.  PC99 card
6.  Memory card
7.  p-Code card
8.  Speech Synthesizer
```

If you select 1:

```
1.  Change path for Disk Controller ROM 0
2.  Change path for Disk Controller ROM 1
```

If you select 1:

```
Current path:
\PC99\MODULES\P1100R0.ROM

New path ?
```

You should enter the DOS path to the Disk Controller ROM 0 file. If either the path, or the size of the file is wrong, the path will not be changed. If you do change the ROM, CFG.EXE will warn:

```
*** WARNING: You must change the peripheral type to match the ROM ***
```

In most cases, it will be easier to use 7. Setup peripheral to change both the ROMs and the type simultaneously.

6.9.3. Display peripheral type

A peripheral can have a "type". The type reflects the original peripheral manufacturer. For example, Texas Instruments, Myarc, and CorComp manufactured disk controllers for the TI-99/4A. In addition, PC99 considers the ROM kit manufactured by John Guion to be a disk controller "type".

IMPORTANT: A type of "none" is the equivalent of removing that peripheral from the p-Box.

A typical display is:

```
Disk Controller card  = 2 = Myarc
RS232 primary card    = 1 = Texas Instruments
RS232 secondary card  = 0 = None
Thermal Printer       = 0 = None
PC99 card             = 0 = None
Memory card           = 1 = Texas Instruments
p-Code card           = 0 = None
Speech Synthesizer    = 1 = Texas Instruments
```

In this example, the PC99 "p-Box" contains a Myarc disk controller, TI RS232 primary card, TI 32K memory card. In addition a TI Speech Synthesizer is available.

6.9.4. Change peripheral type

You can change the peripheral type. For example, you could replace the TI disk controller with the Myarc disk controller.

The next menu is displayed:

```
1.  Disk Controller card
2.  RS232 primary card
3.  RS232 secondary card
4.  Thermal Printer
5.  PC99 card
6.  Memory card
7.  p-Code card
8.  Speech Synthesizer
```

If you select 1:

```
Peripheral type = 1 = Texas Instruments

  1. None
  2. Texas Instruments
  3. Myarc
  4. CorComp
  5. Guion
```

If you select 3:

```
Peripheral type = 2 = Myarc
```

IMPORTANT: If you select 1. None, it is the equivalent of removing that card from the p-Box.

```
*** WARNING: You must change the peripheral ROM(s) to match the type ***
```

In most cases, it will be easier to use 7. Setup peripheral to change both the ROMs and the type simultaneously.

6.9.4.1. Memory card

If you select 6, the next menu is displayed:

```
1.  None
2.  Texas Instruments
3.  Myarc
4.  CorComp
5.  AMS
```

If you select 5, the message:

```
Peripheral type = 5 = AMS

** You need to select the number of AMS banks **
```

is displayed. When you press <Enter>, the next menu is displayed:

```
Banks = 64 (= 256K)

1.  AMS with  32 banks =  128K
2.  AMS with  64 banks =  256K
3.  AMS with 128 banks =  512K
4.  AMS with 256 banks = 1024K
```

If you select 3, you will have an AMS card with 512K of memory.

6.9.5. Setup peripheral

This is a combination of

```
2.  Change peripheral ROMs and GROMs
```

and

```
4.  Change peripheral type
```

The next menu is displayed:

```
1.  Setup peripheral at CRU >1000 (Myarc 512K card)
2.  Setup peripheral at CRU >1100 (Disk Controller card)
3.  Setup peripheral at CRU >1300 (RS232 primary card)
4.  Setup peripheral at CRU >1500 (RS232 secondary card)
```

6.9.5.1. Setup peripheral at CRU >1000 (Myarc 512K card)

If you select 1, the next menu is displayed:

```
1.  Without XB II
2.  With XB II (use 128K OS)
```

If you select 2, you will be able to load Myarc Extended Basic II from disk when you start PC99.

6.9.5.2. Setup peripheral at CRU >1100 (Disk Controller card)

The next menu is displayed:

```
Disk Controller Type     = 1 = Texas Instruments

  1.  Texas Instruments
  2.  Myarc
  3.  CorComp
  4.  Guion
```

If you select 2, the Myarc disk controller ROMs will be loaded, and the peripheral type will be set to Myarc. This is the quickest way within CFG.EXE to change disk controllers.

6.10. Module

TI modules contain one or more 8K ROM chips, and/or one or more 6K GROM chips. When you dump a cartridge with a GRAM device, such as the Gramulator, a separate file is made for each chip in the cartridge. In addition, the GRAM device adds a 6-byte header to each file.

PC99 uses the identical file format.

To "change a command module", you use CFG.EXE to tell PC99 which DOS files to load. These DOS files are byte-for-byte copies of TI files dumped with a GRAM device.

CFG.EXE reads the file PC99.MOD to find out which command modules you have. The format of this file is:

```
[module 1 name]
module 1 filename
module 1 filename1
[module 2 name]
module 2 filename
module 2 filename1
module 2 filename2
module 2 filename3
;[module 3 name]
;[module 3 filename
[module 4 name]
module 4 filename
module 4 filename1
...
$
```

PC99.MOD is an ASCII file that you can edit with an ASCII editor. You only need to edit this file if you add or delete a module, or want to re-order the module list.

Each entry in the file consists of the module name enclosed in square brackets. The module name can be any combination of upper and lower case and need not be the true module name. For example you could have:

`[extended basic]` or `[xbasic]`

Below the name are the DOS filenames of the files that make up the module. The number of files varies depending on the module.

Note: There is no count value in PC99.MOD for the number of files in a module. Each entry below the name is considered to be a DOS filename belonging to the module until the next [name] entry is found, or until an entry with a "$" as the first character is found.

Note: If any entry in PC99.MOD starts with ";" (semi-colon) or "#" (hash mark), it is considered to be a comment. If you use this feature, you would normally comment out an entire module — the [name] and the file entries below it. If you comment out just the [name], the entries below it will be considered file entries belonging to the previous module.

The last line in the PC99.MOD file must contain a "$" symbol.

At the main menu select:

```
9.  Modules
```

The next menu is displayed:

```
 1. Display loaded module names
 2. Display loaded module files
 3. Change module
 4. Check all modules (screen report)
 5. Check all modules (disk report)
 6. Change module count
 7. Print module list
 8. Set up Super Space bank
 9. Display Super Space bank status
10. Set module slot range to "not used"
11. Enable multiple ROM banks
```

6.10.1. Display loaded module names

The TI console software allows for up to 16 modules to be accessed simultaneously. The mechanism is called "REVIEW MODULE LIBRARY". There has only been limited success in implementing the hardware to do this on a real 4A. The hardware is usually called a GROM module box, and attempts to allow up to 16 modules to be electrically connected to the console. With this arrangement, a single bad contact can cause difficulties.

When PC99 emulates this feature, there are no corresponding hardware problems. However, PC99 must have sufficient memory in which to store the modules. For each module that you enable, PC99 will attempt to allocate PC extended memory for it.

In the worst case, a module can have five 8K GROMs and two 8K ROMs. To run 16 modules simultaneously you will need at least 1Mb of PC extended memory over and above that required by PC99.

CFG.EXE allows you to set the number of modules you wish to use under "Change module count". When you "Display module names" only the number of modules enabled is displayed.

If you have set the module count to 3, a typical display is:

```
01. [extended basic]
02. [editor/assembler]
03. [disk manager 2]
```

6.10.1.1. Limitations of REVIEW MODULE LIBRARY feature

Texas Instruments designed the REVIEW MODULE LIBRARY feature to search multiple GROM banks — but not multiple ROM banks.

Even if TI had manufactured a "GROM module box", it would only have permitted one cartridge to have ROM at >6000. For example, if Extended Basic was loaded in slot 1, and Video Chess in slot 2, you would not be able to run Extended Basic because the Extended Basic ROM will be overlaid by the Video Chess ROM. If you select Extended Basic in this case, unpredictable results will occur when Extended Basic attempts to execute its ROM code and ends up executing code in the Video Chess ROM.

If you "Enable multiple ROM banks", PC99 attempts to overcome this feature by "latching" the ROM bank and mapping in the appropriate ROM for the current module. This technique is based on information supplied by Michael Becker, who designed this feature into his HSGPL card.

Since this feature was not built in to the TI console, it is an extension of the emulation. As such, some software will not run when it is enabled. In these cases, disable the feature, and run in normal emulation mode.

6.10.1.2. Applications that do not read the GROM base address

The Texas Instruments GPL specification requires that applications must determine the GROM base address — and should not assume that it is set to >9800. If the PC99 module count is set to 1, the default GROM base address is >9800. However, if the count is greater than 1, the GROMs in slot 2 have a base address of >9804, the GROMs in slot 3 have a base address of >9808, and so on.

If a module is in slot 2, and it assumes the GROM base address is >9800, it will end up executing GPL code in the module in slot 1 and unpredictable results will occur.

The following modules will not run if they are not in slot 1:

PHM 3056	Alpiner
PHM 3158	M*A*S*H
PHM 3177	Facemaker
PHM 3226	Buck Rogers

The designers of these modules did not follow TI's software rules.

In addition, TI Forth will not run if the Editor/Assembler module is not in slot 1.

6.10.2. Display loaded module files

The display depends on the number of modules you have enabled. If you have set the module count to 3, the menu is:

```
1.  Module 01, GROM bank 0
2.  Module 02, GROM bank 1
3.  Module 03, GROM bank 2
```

If you select 1, a typical display is:

```
Module number     = 1
Module name       = [extended basic]
File count        = 6

Num  Load type   Len   Addr  File
01.  0a = RAM 1  2000  6000  \PC99\MODULES\PHM3026.GRM
02.  09 = RAM 0  2000  6000  \PC99\MODULES\PHM30261.GRM
03.  07 = GRM 6  1800  c000  \PC99\MODULES\PHM30262.GRM
04.  06 = GRM 5  1800  a000  \PC99\MODULES\PHM30263.GRM
05.  05 = GRM 4  1800  8000  \PC99\MODULES\PHM30264.GRM
06.  04 = GRM 3  1800  6000  \PC99\MODULES\PHM30265.GRM

Press <Enter> to continue...
```

The remaining two modules are then displayed.

6.10.3. Change module.

The display depends on the number of modules you have enabled. If you have set the module count to 3, the menu is:

```
1.  Module 01, GROM bank 0
2.  Module 02, GROM bank 1
3.  Module 03, GROM bank 2
```

You must first select the module "slot" you wish to change.

After you select a slot, the next display depends on the contents of your PC99.MOD file. Each module name (enclosed in square brackets) is displayed in the order in the file. This allows you to control the order of display. You could, for example, put your modules in alphabetical order, or keep your most-used modules near the beginning of the file for ease of access.

A green bar is placed over the first module name. Use the cursor keys to move the bar up or down. When the bar is over the module you want, press <Enter>.

If you have more than 20 modules, use <Page Up> and <Page Down> to go forward and back 20 modules at a time.

A typical display is:

```
BLUE HEAD   Page 1 of 1
GREEN BAR   001. [addition]
            002. [adventure]
            003. [buck rogers]
            004. [editor/assembler]
            005. [extended basic]
            006. [parsec]
            007. [super extended basic]
            008. [tombstone city]
            009. [video chess]
            010. [zero zap]
```

When you select the module you want, the next screen is displayed:

```
Module number     = 1
Module name       = [buck rogers]
File count        = 3

Num   Load type   Len   Addr  File
01.  09 = RAM 0  2000  6000  \PC99\MODULES\PHM3226.GRM
02.  05 = GRM 4  1800  8000  \PC99\MODULES\PHM32261.GRM
03.  04 = GRM 3  1800  6000  \PC99\MODULES\PHM32262.GRM
```

6.10.3.1. Dummy module

The default PC99.MOD file contains a "module" with the name [dummy] which contains a dummy ROM 0, and dummy GROMs 3-7. This "module" will load >00 at CPU addresses >6000->7FFF and at GROM addresses >6000->F7FF. Loading this module is the equivalent of removing all modules from the console cartridge slot.

If the module count is 1, and you load the dummy "module", the only entry on the TI master selection screen will be: 1. TI BASIC.

6.10.4. Check all modules (screen report).

This allows you to check every filename listed in PC99.MOD. Each file is checked for access, and for file size. At the end, a summary is given.

A typical display is:

```
Module 1: [addition]
Module 2: [adventure]
```

```
...
...
Module 159: [wing war]
Module 160: [zero zap]

Module count = 160

Files not found = 0

Files with bad sizes: 0 out of 535
```

If there are errors during the check, CFG.EXE will display the error and wait for you to press <Enter>.

6.10.5. Check all modules (disk report).

The next screen is displayed:

```
Path for report file ?

c:\tmp\junk
```

The report is written to the disk file c:\tmp\junk. It contains the current time and date from the PC time-of-day clock. Each filename listed in PC99.MOD is checked for access, and for file size. If there are any errors, these are recorded in the disk file. At the end of the file, a report summary is given.

Note: If the file exists you will be given a chance to overwrite or abort.

6.10.6. Change module count

You can enable up to 16 modules. To do this, you should have at least 1Mb of extended memory available for PC99 to use.

When you change the module count, you must ensure that there is a valid module in each slot.

A typical sequence is:

```
Module count      = 1

New value (1 - 16) ?
4

Module count      = 4
```

If you reduce the module count, it is possible that you may have module information in higher slots that you no longer want.

Example: You previously enabled 9 modules, but now only want to use 4:

```
Module count     = 9

New value (1 - 16) ?
4

Module count     = 4

Set module slots 5 - 16 to "not used" ?

1.  Yes
2.  No
```

If you answer yes, slots 5-16 will be set to "not used". If you answer no, the contents of slots 5-16 will be retained.

6.10.7. Print module list

This allows you to print a list of module names to a disk file. A module name is an entry in the PC99.MOD file that is contained in square brackets.

A typical display is:

```
Path for module file ?

c:\tmp\junk
```

Note: If the file exists you will be given a chance to overwrite or abort.

6.10.8. Set up Super Space bank

The next screen is displayed:

```
 1. Bank 0
 2. Bank 1
 3. Bank 2
 4. Bank 3
 5. Bank 4
 6. Bank 5
 7. Bank 6
 8. Bank 7
 9. Bank 8
10. Bank 9
11. Bank 10
12. Bank 11
13. Bank 12
14. Bank 13
15. Bank 14
16. Bank 15
```

If you select 1:

```
Super Space 00 = DISABLED

  1. Enable
  2. Disable
```

If you wish to enable a 32K Super Space module in bank 0 select 1.

This will enable 4 banks of 8K Super Space RAM at >6000->7FFF. These banks are switched using the Super Space bank switching scheme devised by Edgar Dohmann and implemented in the DataBioTics Super Space II product.

6.10.9. Display Super Space bank status

A typical display is:

```
Super Space 00 = DISABLED
Super Space 01 = DISABLED
Super Space 02 = DISABLED
Super Space 03 = DISABLED
Super Space 04 = DISABLED
Super Space 05 = DISABLED
Super Space 06 = DISABLED
Super Space 07 = DISABLED
Super Space 08 = DISABLED
Super Space 09 = DISABLED
Super Space 10 = DISABLED
Super Space 11 = DISABLED
Super Space 12 = DISABLED
Super Space 13 = DISABLED
Super Space 14 = DISABLED
Super Space 15 = DISABLED
```

6.10.10. Set module slot range to "not used"

This allows you to set a contiguous range of module slots to "not used", the PC99 default blank entry.

If you change the module count and enter new modules, and then reduce the module count, you can choose whether to retain the entries for the higher modules in PC99.CFG. You can do this in case you wish to re-use them. When PC99 starts up, it only reads as far as the highest module entry equal to the module count. For example, if the module count is 1, then entries for slots 2-16 are ignored. It does not matter what entries are in the ignored slots.

The default PC99 configuration has a module count of 1, Extended Basic in slot 1, and "not used" in slots 2-16. If you lower the module count and retain the higher entries, you may wish to set selected module slots to the PC99 default values.

To set a range of slots to "not used":

```
9.  Set module slot range to "not used"
```

A list showing the contents of all slots is displayed, followed by the prompt:

```
Module slot range (low,high) ?
Ex: 3,8 (low >= 2, high <= 16, low <= high)
```

Enter the range in decimal digits separated by a comma. The low value must be > = 2, the high value must be < = 16, and the low value must be < = to the high value. If any of these conditions are false, the slots are not cleared.

6.10.11. Enable multiple ROM banks

The next screen is displayed:

```
Multiple ROMs enabled  = 1 = ENABLED

New value (0 = Disable, 1 = Enable) ?
```

If you select 1, then multiple ROM banks are enabled.

This feature is an extension of the TI-99/4A emulation. Up to 16 ROM banks can be enabled for use with up to 16 ROM-based modules. This feature is based on a similar feature in the HSGPL card developed by Michael Becker in Germany.

Because this was not part of the original TI design, it can fail under certain circumstances:

1. ROM-only cartridges
   These include most of the Atari cartridges, such as Moon Patrol. The console power-up routine is set to search GROM and will not find the header in a ROM-only cartridge. Thus if you enable this feature, and load Moon Patrol, the TI selection list will only show 1. TI BASIC. To run ROM-only cartridges, you must disable this feature.

2. "Bad" cartridges
   TI published a specification for cartridge development. One of the rules included that the cartridge had the responsibility of determining its GROM base address, and not just assuming that it was >9800. Some cartridges, including those developed by TI, did not follow these rules. These cartridges will cause problems when this feature is enabled. To run these cartridges, you must disable this feature.

3. Combining non-standard features
   If you combine too many non-standard features, such as enabling multiple ROM banks with say an OPA console, the interacting components may cause the emulation code to fail. It is unlikely that CaDD will attempt to fix problems caused by these situations, provided the emulation of each feature works when this feature is disabled.

6.11. Color

A TI screen contains 256w x 192h pixels. In bitmap mode, all on pixels in a group of 8 pixels (modulo from left) can be one of 16 TI colors. All off pixels can be one of 16 TI colors. This means that in any group of 8 pixels, there can only be two colors.

PC99 emulates this by driving the VGA screen in 320w x 200h mode. Although the PC allows each pixel to be one of 16 colors, PC99 emulates the TI scheme.

You use CFG.EXE to change the RGB (red-green-blue) components of each PC color until they match the TI color as closely as possible. The accuracy of the match depends on your eye, surrounding conditions, and the quality of your VGA display and monitor card.

At the main menu select:

```
10.  Color
```

The next menu is displayed:

```
1.  Change TI colors
```

If you select 1, the screen shows 16 colors corresponding to the 16 TI colors. You can move to a color by using the cursor keys. The current color is underlined.

You can change the RGB values of a color by using the R, G and B keys. Shift a key to increase the amount of color and use the unshifted key to decrease the amount of color.

You can change the RGB values simultaneously by using the A key. Use shift A to increase each RGB value for a color, and unshift A to decrease each RGB value for a color.

Press <F1> to get a help screen.

Press <F10> to restore the colors to their default values.

Although you can adjust all the colors, it is not advisable to adjust colors 0 and 1 from their default values.

Press <q> or <Esc> to exit the color screen and return to the menu. Before you quit CFG.EXE you should save the configuration.

When PC99 is loaded, it will use the new color values.

6.12. Status

You can display the status of all variables that can be set or changed using CFG.EXE. A "variable" can be a number, such as the default debug mode, or a string, such as the path to the keyboard file.

At the main menu select:

```
11.  Status
```

The next menu is displayed:

```
1.  Display configuration status
2.  Print status to disk file
3.  Display PC info
```

6.12.1. Display configuration status

The next menu is displayed:

```
1.  All
2.  RS232
3.  Sound
4.  Joysticks
5.  System
6.  Disks
7.  Keyboard
8.  Console
9.  Peripherals
10. Module
11. Color
```

You can display the status of all configuration variables over a number of screens, or you can display specific variables.

If you choose 7, a typical display is:

```
Keyboard    = \PC99\PC994A.KEY
Path        = good
Size        = 2349 bytes = good

Key age     = 1500
```

6.12.2. Print status to disk file

You can print all configuration variables to a disk file in ASCII format. You can use DOS to print the file, or you can import it into an ASCII editor or a word processor, such as WordPerfect.

The next screen is displayed:

```
Path for status file ?
```

Enter the DOS path of the file. If the DOS file exists, you will be warned:

```
*** WARNING: File exists ***
1.  Overwrite
2.  Abort
```

If you choose 1. the existing file will be overwritten. If you choose 2. you are returned to the previous menu.

6.12.3. Display PC info.

This displays the PC date and time; DOS version; video adapter type and whether supported; if a VESA BIOS is supported; the amount of SVGA memory and chipset; and keyboard type.

6.13. Save

If you have made one or more changes to the PC99 configuration, and you want those changes in effect the next time you start PC99, you must save the changes.

At the main menu select:

```
12.  Save
```

The next menu is displayed:

```
1.  Save configuration
2.  Save configuration and quit
```

6.13.1. Save configuration

A typical display is:

```
Checking configuration...
Checking RS232...
Checking sound...
Checking joysticks...
Checking system variables...
Checking disks...
Checking keyboard...
Checking console ROM and GROMs...
Checking peripherals...
Checking module count...
Checking modules...
Checking colors...
Saving PC99.CFG to PC99.CFX
      1 file(s) copied
Write complete
```

CFG.EXE checks to see that all values are within range. For example, it would be an error for the default debug mode to be less than 0 or greater than 4. For files, CFG.EXE checks to see if they can be accessed. For disks, ROMs and GROMs, the file sizes are checked.

The existing PC99.CFG is copied to PC99.CFX. Then the new PC99.CFG file is created. This allows you to recover the old configuration if you need it.

6.13.2. Save configuration and quit

This is identical to a "Save configuration", except that you are returned to DOS after the file PC99.CFG is written to disk.

This is the preferred way to exit CFG.EXE.

6.14. Defaults

You can configure PC99 to use default values. This could be useful if you have been "playing" with CFG.EXE, or you need to get the configuration values into a known state.

At the main menu select:

```
13.  Defaults
```

The next menu is displayed:

```
1.  Display PC99 default configuration values
2.  Set all configuration values to PC99 defaults
```

6.14.1. Display PC99 default configuration values

The next menu is displayed:

```
 1. All
 2. RS232
 3. Sound
 4. Joysticks
 5. System
 6. Disks
 7. Keyboard
 8. Console
 9. Peripherals
10. Module
11. Color
```

You can display the default configuration variables over a number of screens, or you can display specific variables.

If you choose 2, a typical display is:

```
RS232/1 = 1 = Map to PC COM1
RS232/2 = 2 = Map to not used
RS232/3 = 0 = Map to not used
RS232/4 = 0 = Map to not used
PIO/1   = 1 = Map to PC LPT1
PIO/2   = 0 = Map to not used
```

The default values are the values that will be used if you select "Set all configuration values to PC99 defaults".

6.14.2. Set all configuration values to PC99 defaults

A typical display is:

```
PC99 default values set. Count = 1005
You must save this configuration before exiting.
```

If you save the configuration the default values will be in effect the next time you start PC99. The count value is the number of variables that CFG.EXE keeps track of.

6.15. Test

This section allows you to test the serial ports and mouse driver on your PC. You must have a loopback connector (NOT a null modem) for the serial port tests to work. Preferably, the loopback connector should have LEDs for DTR, DSR, RTS and CTS serial lines.

At the main menu select:

```
14.  Test
```

The next menu is displayed:

```
1.  Transmit/receive test
2.  Modem control register test
3.  Terminal emulation test
4.  Mouse driver test
```

6.15.1. Transmit/receive test

The next menu is displayed:

```
1.  Test PC COM 1
2.  Test PC COM 2
3.  Test PC COM 3
4.  Test PC COM 4
5.  Test PC COM 5 (MCA only)
6.  Test PC COM 6 (MCA only)
7.  Test PC COM 7 (MCA only)
8.  Test PC COM 8 (MCA only)
```

If you select 1:

```
Baud rate for test:
1.   110
2.   150
3.   300
4.   600
5.  1200
6.  2400
7.  4800
8.  9600
9. 19200
```

f you select 8, the PC COM 1 port is set to 9600 baud. Next the string:

```
≡≡≡ PC99 transmit/receive text ≡≡≡
```

is transmitted out of COM 1 one byte at a time. Each byte travels around the loopback bit by bit and is received by COM 1. When the received bits are re-assembled into a byte, CFG.EXE receives an interrupt that a character is waiting at COM 1.

CFG.EXE reads the character and displays it on the screen. At the end of transmission the transmitted string is compared to the received string. If they match, the port is supported by PC99 at the tested rate.

Note: The ≡ character is ASCII 240, and can be keyed by holding <Alt>, and pressing 2, 4 and 0 on the numeric keypad. This character is used as part of the test since it has the most significant bit (MSB) on.

6.15.2. Modem control register test

The next menu is displayed:

```
1.  Test PC COM 1
2.  Test PC COM 2
3.  Test PC COM 3
4.  Test PC COM 4
5.  Test PC COM 5 (MCA only)
6.  Test PC COM 6 (MCA only)
7.  Test PC COM 7 (MCA only)
8.  Test PC COM 8 (MCA only)
```

If you select 1, CFG.EXE attempts to set and clear DTR (Data Terminal Ready) on COM1, and then set and clear RTS (Request to Send). A typical display is:

```
Port COM1 open

Setting DTR...
DTR set
Press <Enter> to continue...
Clearing DTR...
DTR cleared
Press <Enter> to continue...
Setting RTS...
RTS set
Press <Enter> to continue...
Clearing RTS...
RTS cleared

Port COM1 closed

Press <Enter> to continue...
```

The appropriate LEDs on the loopback connector will light for each step.

6.15.3. Terminal emulation test

The next menu is displayed:

```
1.  Test PC COM 1
2.  Test PC COM 2
3.  Test PC COM 3
4.  Test PC COM 4
5.  Test PC COM 5 (MCA only)
6.  Test PC COM 6 (MCA only)
7.  Test PC COM 7 (MCA only)
8.  Test PC COM 8 (MCA only)
```

If you select 1:

```
Baud rate for test:
1.   110
2.   150
3.   300
4.   600
5.  1200
6.  2400
7.  4800
8.  9600
9. 19200
```

If you select 5, CFG.EXE clears the screen and displays:

```
Port = COM1, baud rate = 1200, Press <Esc> to quit
```

You are now in terminal emulation mode. If you press a key, the ASCII value of the key is sent to COM 1. CFG.EXE will receive an interrupt if the character arrives at the port. If so, it will display the character on the screen.

Remember, that although it seems obvious that pressing a <G> should display the <G> on the screen, the actual process was: read the keyboard, take the character and send it to COM 1, the byte traverses the loopback, get an interrupt from COM 1, read the character, display it on the next screen position.

Note: For this terminal emulation a backspace will move the cursor one position to the left. A carriage return will start a new line.

Note: For tests 1 and 3 you may be able to substitute a modem for the loopback connector.

6.15.4. Mouse driver test

The screen will be placed in 320 x 200 mode and a graphics mouse cursor will be displayed. You should be able to move your mouse and see the displayed x-y values change.

Press <Esc> to return to the previous menu.

6.16. Shell

If you need to do something in DOS while you are running CFG.EXE, you can "shell" to DOS. CFG.EXE issues a terminate and stay resident call to DOS and then brings up the DOS prompt.

At the main menu select:

```
15.  Shell
```

The next menu is displayed:

```
1. Shell to DOS
```

If you select 1:

```
Secondary command processor loaded.
C:\COMMAND.COM
Type "exit" to return to CFG.EXE

Microsoft(R) Windows 95
      (C)Copyright Microsoft Corp 1981-1995.

C:\PC99>
```

The DOS version depends on the version of DOS on your PC. In the above example CFG.EXE was running in a DOS box under Windows 95.

If you use MEM /C, you will see where CFG.EXE is loaded. It uses about 56K of DOS (conventional) memory. The rest of CFG.EXE exists in extended memory since it is a protected mode application.

Once in DOS you can do most things. The most common thing to do would be to check for a file and/or its directory. If you try to run a large program you will probably get an out of memory message since a portion of CFG.EXE is still resident.

When you have finished in DOS, type "exit" at the DOS prompt and you will be returned to CFG.EXE.

6.17. Quit

You can Quit from CFG.EXE any time the main menu is displayed.

At the main menu select:

```
16.  Quit
```

If no changes have been made to the configuration you will be returned to the DOS prompt.

If changes have been made to the configuration, the next menu is displayed:

```
1.  Quit to DOS without saving configuration
2.  Save configuration and then quit to DOS

*** WARNING: n changes to configuration not saved ***
```

where n is the number of changes that have been made.

6.17.1. Quit to DOS without saving configuration

Any changes you have made to the configuration are lost. You are returned to the DOS prompt.

6.17.2. Save configuration and then quit to DOS

The Save routine is called. The existing PC99.CFG is copied to PC99.CFX. Then the new PC99.CFG file is created. You are then returned to the DOS prompt.

6.18. CFG.EXE switches

CFG.EXE is designed as a menu-driven program. Most TI-99/4A users would be comfortable using it since many TI programs are menu-driven.

However, in systems that have an operating system — such as a PC running under DOS, or a Sparc Ultra running under Solaris (Unix) — it is much less common to have menu-driven programs. Instead, programs are driven by "switches".

A common example of using a switch in DOS is with the dir utility. At the DOS prompt, if you type:

```
> dir
```

you will get a listing of all files in the current directory showing file size in bytes, and date and time of creation. If you only need to see the filenames, you can enter:

```
> dir /w
```

The "/w" is a switch to the dir program that tells it to display files in "wide" format (no file size, date or time). DOS treats "/" and "-" as equivalent characters for switches.

With an operating system, programs can call or "exec" other programs. The calling program controls the behavior of the called program by passing it one or more switches. (Of course, the called program must be designed to do this.)

CFG.EXE has the following convenient switches which you may optionally use. You will usually find that using switches is faster than using the menus.

You can display the switches available by giving CFG.EXE an invalid switch.

Example:

```
> cfg /x
```

will display a usage message showing all the switches that can be used.

6.18.1. Display console status (/c)

The switch is /c, or -c. At the DOS prompt, if you type:

```
> cfg /c
```

the current paths for the console ROM and GROMs will be displayed.

6.18.2. Display disk paths (/d)

The switch is /d, or -d. At the DOS prompt, if you type:

```
> cfg /d
```

the current paths for DSK1, DSK2, DSK3, DSK4, CS1 and CS2 will be displayed. This display will also show you the values of the read/write flags for each disk.

6.18.3. Display joystick status (/j)

The switch is /j, or -j. At the DOS prompt, if you type:

```
> cfg /j
```

the current status of the joysticks will be displayed.

6.18.4. Display keyboard status (/k)

The switch is /k, or -k. At the DOS prompt, if you type:

```
> cfg /k
```

the current status of the keyboard will be displayed.

6.18.5. Display or change module (/m)

The switch is /m, or -m. This displays the name of the current module, as stored in PC99.MOD, and the files associated with it.

To change a module, you must follow the switch with the module name. You only need type as much of the module name that makes the name unique.

This causes CFG.EXE to search the PC99.MOD file. All names are converted to upper case for the match. Also note that the first name found will be accepted.

Example:

```
> cfg /m extended basic
```

will change the module to Extended Basic.

Example:

```
> cfg /m TOM
```

will change the module to Tombstone City. Note that this would fail if there was a module called Tomahawk and it was ahead of Tombstone City in PC99.MOD.

Example:

```
> cfg /m addition AND sub
```

will change the module to Addition and Subtraction 1. If you want Addition and Subtraction 2, you will have to type the whole name. In this case, you may wish to shorten the name in PC99.MOD. For example, you could name the modules: [addsub1] and [addsub2].

Note: This switch can only be used to change the module in slot 1.

6.18.6. Display or change peripheral (/p)

The switch is /p, or -p. This displays the type of each peripheral. A typical display is:

```
1.  Disk Controller:
    Type      = 2 = Myarc
2.  RS232 primary card:
    Type      = 1 = Texas Instruments
3.  RS232 secondary card:
    Type      = 0 = None
4.  Thermal Printer:
    Type      = 0 = None
5.  PC99 card:
    Type      = 0 = None
6.  Memory card:
    Type      = 5 = AMS
7.  p-Code card:
    Type      = 0 = None
8.  Speech Synthesizer:
    Type    = 1 = Texas Instruments
```

To change the type of a peripheral, you must follow the switch with the peripheral number (1 - 8) and the peripheral type (0 - 5). The peripheral number is the order above. The allowable types are:

```
0 = none
1 = TI
2 = Myarc
3 = CorComp (not supported)
4 = PC99 (for PC99 "card")
5 = AMS
6 = Guion
```

All allowable types are also shown in the CFG.EXE usage message.

Example: If the p-Code card (peripheral number 7) is of type none (0) and you wish to use the TI card (type 1):

```
> cfg /p 7 1

Checking configuration...
Checking RS232...
Checking sound...
Checking joysticks...
Checking system variables...
Checking disks...
Checking keyboard...
Checking console ROM and GROMs...
Checking peripherals...
Checking module count...
Checking modules...
Checking colors...
Saving PC99.CFG to PC99.CFX
      1 file(s) copied
Write complete

p-Code card:
Type    = 1 = Texas Instruments
```

will enable the p-Code card the next time PC99 is started. CFG.EXE calls the save routine which checks all values in PC99.CFG, saves the old PC99.CFG to PC99.CFX, and then writes a new PC99.CFG.

Example: You wish to change the Disk Controller (peripheral number 1) to type Guion (6):

```
cfg /p 1 6
```

6.18.7. Display RS232 status (/r)

The switch is /r, or -r. At the DOS prompt, if you type:

```
> cfg /r
```

the current status of the RS232 and PIO ports will be displayed.

6.18.8. Display or change sound (/s)

The switch is /s or -s. This displays the status of the sound type.

Example:

```
> cfg /s

Sound = 0 = No sound
```

To change the sound type, follow the switch with a value between 0 and 3. The values are:

```
0.  No sound
1.  One-channel sound using PC speaker
2.  Sound Blaster
3.  Sound Blaster compatible
```

Example:

```
> cfg /s 2

Sound = 2 = Sound Blaster
```

You should have a genuine Sound Blaster installed if you use this value.

6.18.9. Toggle startup info (/u)

The switch is /u, or -u. At the DOS prompt, if you type:

```
> cfg /u
```

and the display startup info is NO, it will be set to YES.

6.18.10. Display system status (/y)

The switch is /y, or -y. At the DOS prompt, if you type:

```
> cfg /y
```

the current status of the system variables will be displayed.

6.19. How to generate a default PC99.CFG file (CFGGEN.EXE)

If your PC99.CFG file becomes damaged, you can create a new default file that can then be configured to your system. You use the utility CFGGEN.EXE which lives in \PC99\UTIL. The syntax is:

```
cfggen <config file name>
```

Example: To create a new default configuration file for PC99:

```
> c:
> cd \pc99
> copy pc99.cfg pc99old.cfg
> \pc99\util\cfggen pc99.cfg
```

This saves the old configuration file and creates a new one in the \PC99 directory. CFGGEN.EXE displays each configuration section created, the number of items in each, and a total count of items in the configuration file.

7. 99/4A emulator

This section covers the use of PC99.EXE, the 99/4A emulator.

7.1. Loading PC99

This section assumes you have installed PC99 on your C: hard drive using the instructions supplied with the PC99 master disk. If you have used another drive, then substitute that letter.

To load PC99 from the DOS prompt:

```
> c:
> cd \pc99
> pc99
```

- The program PC99.EXE reads the file PC99.CFG, which is assumed to be in the current directory. (If Display startup info is set to YES, PC99.EXE will display information about each file it has loaded into memory, showing its location and size. Press <Enter> to load the next file.)

- PC99.EXE sets the PC video mode to correspond to the default debug mode. Typically this is 320w x 200h x 256-colors. In this mode you will then see a 256w x 200h cyan square, representing the TI screen.

- The TI title screen (color bar screen) will appear. You can now use PC99 as if you were on a TI-99/4A.

7.2. Quitting PC99

Press <Esc>. The current debugger screen is displayed. The debugger prompts with a question mark (?) and waits for a command. Press <Q> (upper case q) to return to DOS.

Note: All work in progress, such as a Basic program that has not been saved to disk, will be lost.

7.3. PC99 display

PC99 drives the PC video display in one of three PC video modes:

1. Mode 3. This is a text-only mode used for displaying error messages.

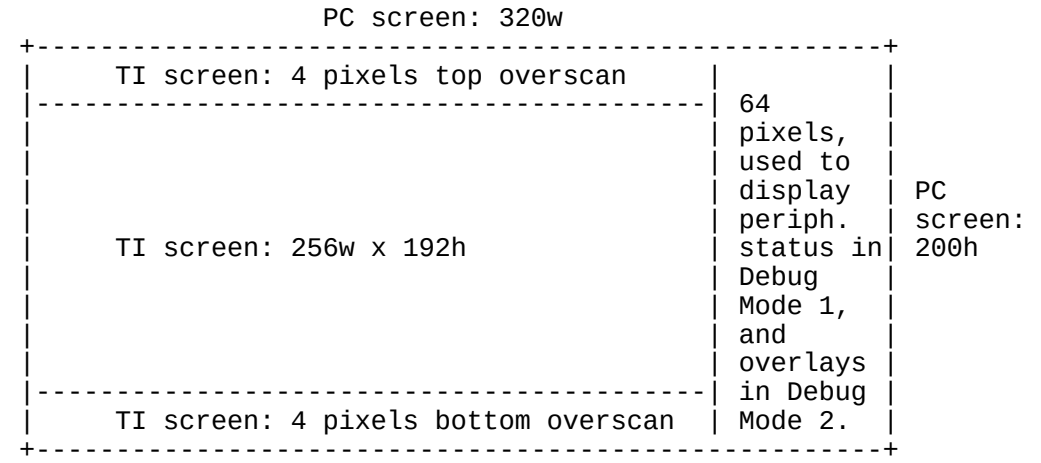
2. VGA mode 18: 640h x 480w x 16 colors. This video mode is used by the mini-screen and TI aspect ratio debug modes.

3. VGA mode 19: 320h x 200w x 256 colors. This video mode is used by all other debug modes.

VGA modes 18 and 19 require a VGA adapter (or better) and color monitor.

The 99/4A display is 256h x 192w x 16-colors, but each pixel in a group of 8 horizontal pixels can only be one of two colors.

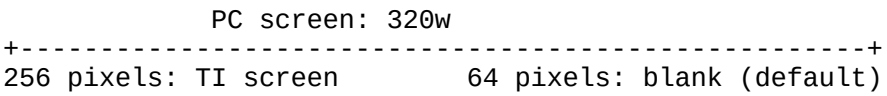
The diagram below shows how most debug modes represent the TI screen on the PC screen:


PC screen: 320w
TI screen: 4 pixels top overscan
64 pixels, used to display periph. status in Debug Mode 1, and overlays in Debug Mode 2.
TI screen: 256w x 192h
PC screen: 200h
TI screen: 4 pixels bottom overscan

- Vertical
  The TI screen is 192 pixels high. The PC screen is 200 pixels high. The 8 pixels left over are split 4 and 4 and displayed at the top and bottom of the TI screen. These pixels are used to show the same top and bottom overscan (or background color) as the TI screen:

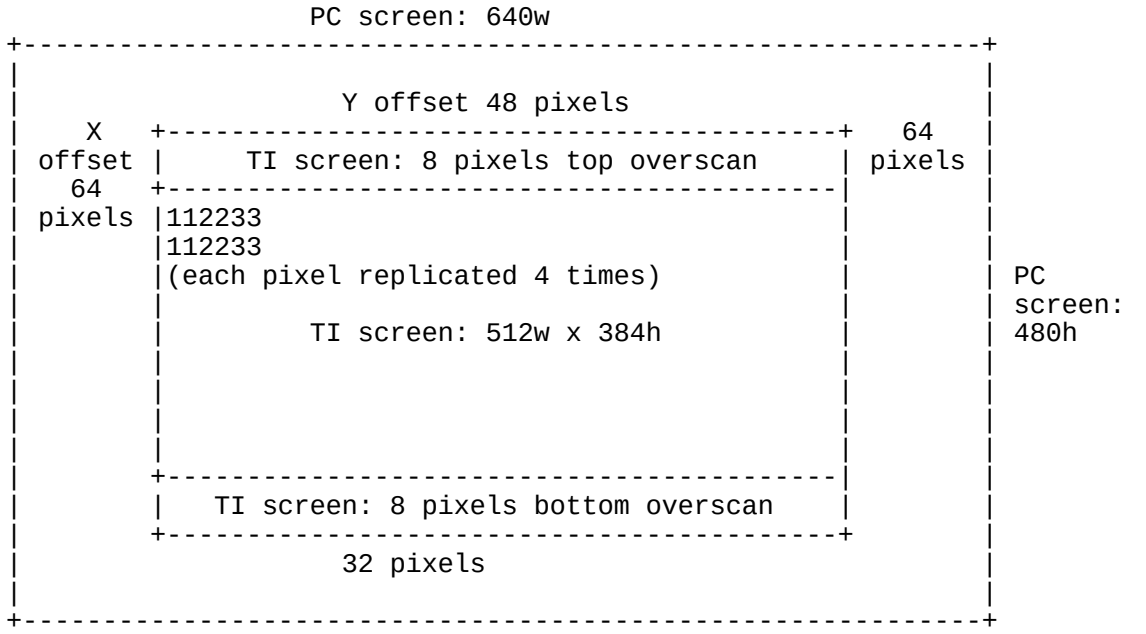
```
  4 pixels: top overscan        +
192 pixels: TI screen           | PC screen: 200h
  4 pixels: bottom overscan     +
```

- Horizontal
  The TI screen is 256 pixels wide. The PC screen is 320 pixels wide. The 64 pixels left over are set to the right. This area is blanked by default. Debug Mode 1 uses this area to display information.



7.3.1. TI aspect ratio mode

If you set the debug mode to TI aspect ratio, the screen is displayed as follows using the default values:



You can set the X offset in the range 0-127, and the Y offset in the range 0-95. This will position the TI screen on the PC screen.

Note that the debug prompt is displayed on the last line of the screen, and can overwrite the displayed TI screen if the Y offset is 88 or greater.

7.4. Connecting devices to the PC COM port

The Electronics Industries Association (EIA) RS232C standard classifies devices into Data Terminal Equipment (DTE) and Data Communication Equipment (DCE). The RS232C standard connector has 25 pins designated as follows:

PIN	*DTE*		*Mnemonic*		*Direction*
1	Protective ground				
2	Transmitted Data		TXD		->
3	Received Data		RXD		<-
4	Request to send	RTS		->	
5	Clear to send		CTS		<-
6	Data set ready		DSR		<-
7	Signal ground				
8	Data carrier detect		DCD		<-
11	Select standby				->
15	Transmit signal element timing				<-
17	Receive signal element timing				<-
18	Test				->
20	Data terminal ready		DTR		->
22	Ring indicator				<-
23	Speed select				->

For Data Communications Equipment (DCE) TXD is assigned to pin 3 and RXD to pin 2. Not all pins are required.

Note: The RS in RS232 stands for Recommended Standard. The C implies that the standard has been revised three times.

IBM classifies PC COM ports as DTE. TI classifies its RS232 card as DCE.

When connecting devices of like class with a cable (e.g. DTE to DTE), the cable wiring will "cross over" pins 2 and 3 (TXD and RXD) and pins 6 and 20 (DSR and DTR). The null modem cable which can connect two PCs by their COM ports is an example of this.

A modem is classified as DCE. When a PC COM port is connected to a modem, the cable wiring is "straight through". The PC AT modem cable is an example of this.

Therefore, when connecting the PC COM port to the TI RS232 port (DTE to DCE) a "straight through" or PC AT modem cable is required.

The cable has the following pinouts:

TI		IBM
1	-	1
2	-	2
3	-	3
6	-	20
7	-	7
20	-	6

7.5. Using serial ports to transfer Basic programs

For this example, assume that PC99 has its RS232/1 port mapped to COM1 and that you want to copy a program from a 4A to PC99.

TI Basic and Extended Basic permit you to use OLD and SAVE to RS232. To use this feature connect your PC COM1 port to the RS232 card on a TI-99/4A system using a cable wired "straight through", as above.

On the 4A OLD a Basic program from disk or cassette.

On the 4A do a SAVE RS232.

On PC99 do an OLD RS232.

The number 255 will appear at the top of both screens and will count down as the program is transferred. In similar fashion, you can SAVE a Basic program from PC99 to a 4A system.

You can speed up the transfers by using higher baud rates, but the rate must be the same on both ends. PC99 supports transfers up to 9600 baud. To allow for differences in PCs, a speed of 2400 baud is recommended.

Note: The Basic program must be a program image file or else the transfer will fail. You cannot transfer Extended Basic INT/VAR 254 files. Trying a similar transfer between two 4A systems will fail too. This is a limitation of the TI system in that the file to be transferred must fit in VDP memory.

7.6. Controlling sound in PC99

When PC99 is running you can turn sound on or off.

- If sound is on, and you want it off:
  Press <Esc> to go to the debugger. At the debugger prompt type "soff" (sound off). Any sound in progress is stopped instantly. Press <c> to continue. You are returned to the application screen. Sound is now disabled.

- If sound is off, and you want it on:
  Press <Esc> to go to the debugger. At the debugger prompt type "son" (sound on). Press <c> to continue. You are returned to the application screen. Sound is now enabled.

7.7. PC99 "card"

The PC99 "card" is a software-only peripheral that can be enabled with CFG.EXE. "Software-only" means that this "card" does not emulate a real piece of TI or third-party hardware. However, when PC99 is running, it sees this "card" as a normal peripheral based at CRU address >1B00. The "card" has a Device Service Routine (DSR). The default DSR supplied by CaDD includes support for a real-time clock. You can add to or replace this DSR with one that you create.

When you enable the PC99 card with CFG.EXE, you can access a real-time clock from Basic:

```
100 CALL CLEAR
110 OPEN #1:"CLOCK"
120 INPUT #1:A$,B$,C$
130 PRINT A$,B$,C$
140 CLOSE #1
```

A$ contains the string representation of the day of the week (0-6 = Mo-Su)
B$ contains the string representation of the year (mm/dd/yy)
C$ contains the string representation of the hour (hh/mm/ss)

This format matches the one used by the CorComp Triple-Tech card. Note that the INPUT statement must always contain 3 string variables.

PC99 treats the addresses >5FF0->5FFF in the PC99 DSR space as "clock registers". When a call to the clock is made, PC99 will read the DOS date and time, and encode it into these addresses. The DSR will access these "registers" and return the values to the calling program. The calling program thus gets the PC time and date.

The DSR supports OPEN, INPUT, PRINT, and CLOSE. Note that although PRINT is supported, the values are not used to change the PC time of day clock. To do this you should use the DOS utilities DATE and TIME, or the Windows Control Panel.

7.8. Mechatronic Extended Basic II Plus

CaDD Electronics has negotiated an arrangement with Mechatronic Elektronische Bauelemente GmbH & Co, Germany that allows us to distribute the Mechatronic Extended Basic II Plus command module in PC99 format. This module contains many useful extensions to TI Extended Basic, including the capability to use high-resolution bitmap graphics. The distribution package consists of:

1. Files representing the Mechatronic Extended Basic II Plus command module.

2. An Adobe Acrobat .pdf file containing the Mechatronic Extended Basic II Plus manual.

3. A PC99 .dsk file (mechaxb.dsk) containing all the examples in the manual.

These files were stored on your hard drive during PC99 installation.

7.8.1. Loading XBII+

To use the XBII+ module

```
> c:
> cd \pc99
> cfg /m mecha
> pc99
```

7.8.2. Reading XBII+ documentation

The XB II+ manual is supplied as an Adobe Acrobat 3.0 portable document format (pdf) file. You must be running Windows 3.1, Windows 95 or Windows 98 and have the Adobe Acrobat Reader (or Adobe Acrobat Exchange) to view .pdf files. The Acrobat Reader is available free from Adobe Systems Incorporated or can be ordered from CaDD Electronics on 3.5" disk at a nominal charge.

To view the XBII+ manual, start the Acrobat Reader, and then use its File menu to open the mechaxb.pdf file (\pc99\doc\mechaxb.pdf). When the manual is displayed you can Acrobat to: Search for any text in the document; and print the document using your Windows printer driver.

If you do not have a copy of the Adobe Acrobat Reader (or Adobe Acrobat Exchange), you can download the Reader from Adobe's web site at www.adobe.com. Alternatively, CaDD can supply you with a 3-disk set containing the Reader for $5.00 This charge covers cost of duplication, disks, and postage. The Reader software is free. Please state whether you require the Acrobat Reader for Windows 3.1 (16-bit) or Windows 95/98 (32-bit).

Acrobat(R) Reader copyright(C) 1987-1996 Adobe Systems Incorporated. All rights reserved. Adobe and Acrobat are trademarks of Adobe Systems Incorporated.

7.8.3. Using MECHAXB.DSK

The following illustrates one of the recommended methods. *Note*: This method will destroy the contents of DSK1.

```
> c:
> cd \pc99\dsk
> copy mechaxb.dsk dsk1
> cd ..
> pc99
```

PC99 will load. Press any key at the TI title screen, then press 2 for Mechatronic Extended Basic II Plus. At the XB II+ prompt:

```
> CALL APESOFT
> OLD DSK1.3083SPIRAL
> RUN
```

This will produce a high-resolution square spiral.

CaDD Electronics would like to acknowledge the generosity of Mechatronic Elektronische Bauelemente GmbH & Co, D-71065 Sindelfingen, Germany, in allowing us to distribute its copyrighted software as shareware. You are requested to contribute $5.00 to Mechatronic if you use it.

We would also like to thank Carsten Ziepke and Charles Good for their help in putting together this package.

7.9. PC99 debugger

You access the PC99 debugger by pressing <Esc> at any time. The TI application is suspended, and the debugger displays a question mark (?) prompt and waits for input. The debugger screen displayed depends on the debugger mode. The initial debugger mode is set with CFG.EXE.

There are five debugger modes available:

Mode 0. PC99 displays a standard TI screen (in 320 x 200 PC mode). Nothing is displayed in the 64-pixel area to the right of the TI screen. The debugger prompt is displayed at the bottom right of the TI screen.

Mode 1. PC99 displays a standard TI screen (in 320 x 200 PC mode). VDP and peripheral status information is displayed in the 64-pixel area to the right of the TI screen:

ROW 1:	{- / | \\} These characters are displayed in rapid succession to create a spinning "wheel". When the wheel is spinning the keyboard CRU lines are active. If not displayed, the "wheel" can be turned on with the debugger command "kbon".
ROW 2:	c PC99 The "c" is the ASCII representation of the last key pressed on the keyboard. "PC99" is the product name.
ROW 3:	vYYMMDD (version number, useful for customer support)
ROW 4:	Blank.
ROW 5:	Disp {on | off}. The TI screen display is on, or off depending on the value in VDP R1. When the display is off, PC99 does not update the TI screen.
ROW 6:	Mode {Bit | Gra | Mul | Txt}. The current graphics mode: bitmap, graphics, multicolor or text.
ROW 7:	Scn {4-digit hex address} The base address of the VDP screen image table.
ROW 8:	Col {4-digit hex address} The base address of the VDP color table.
ROW 9:	Pat {4-digit hex address} The base address of the VDP pattern name table.
ROW 10:	Blank.
ROW 11:	D/C {No | TI | Gu | My} The Disk Controller peripheral. Type can be No, TI, Gu(ion) or My(arc).
ROW 12:	RSp {No | TI | Gu} The RS232 primary peripheral (RS232, RS232/1, RS232/2, PIO, and PIO/1). Type can be No, TI or Gu(ion).
ROW 13:	RSs {No | TI | Gu} The RS232 secondary peripheral (RS232/3, RS232/4, and PIO/2). Type can be No, TI or Gu(ion).

ROW 14: TP {No | TI}
The Thermal Printer peripheral (TP). Type can be No, or TI.

ROW 15: PC99 {No | P9).
The PC99 peripheral. The default, supplied by CaDD, contains support for OPEN #1:"CLOCK". You can create your own DSRs by replacing this "peripheral". Type can be No, or P9 (PC99).

ROW 16: Mem {No | TI | My | AMS}
The Memory peripheral. Type can be No, TI (32K), My(arc) (512K with or without XB II support), or AMS (128K, 256K, 512K or 1Mb).

ROW 17: pCod {No | TI}
The p-Code peripheral. Type can be No, or TI. When set to type TI, the power-up routine in this peripheral does not display the TI title screen.

ROW 18: Spch {No | TI}
The Speech Synthesizer peripheral. Type can be No, or TI.

ROW 19: Blank.

ROW 20: DSK1 rw {RW | RO | OR}
The DSK1 peripheral. When this peripheral is read from a green block is displayed at "r". When this peripheral is written to, a red block is displayed at "w". The peripheral can be RW (read/write), RO (read-only), or OR (operating system read-only [a protected file set with the DOS attrib command (or through Win 95)]).

ROW 21: DSK2 rw {RW | RO | OR}
Same as DSK1.

ROW 22: DSK3 rw {RW | RO | OR}
Same as DSK1.

ROW 23: DSK4 rw {RW | RO | OR}
Same as DSK1. Only displayed if Disk Controller is type Myarc.

ROW 24: Reserved for debug response, e.g. Cmd Done.

ROW 25: Reserved for debug prompt and for status or error messages. spch wt means that an attempt was made to write to the speech synthesizer. RS232/2 means that the RS232/2 port has been initialized. NNNNwR0 means that an attempt was made to write to address NNNN in ROM 0 (not allowed by PC99).

Mode 2. PC99 displays a standard TI screen (in 320 x 200 PC mode). The contents of the overlay file are displayed in the 64-pixel area to the right of the TI screen.

Mode 3. PC99 displays a mini TI screen (in 640 x 480 PC mode). The rest of the screen is filled with editable debugging objects.

Mode 4. PC99 displays a full TI screen (in 640 x 480 PC mode). Each TI pixel is replicated four times. The size of the TI screen is 512w by 384h with 8 pixels of overscan above and below. The X and Y offsets to the start of the TI screen can be set with CFG.EXE.

In all debugger modes you can press:

?	to get help (list of debugger commands)
c	to continue with the application
Q	(upper case q) to quit to DOS

All debugger commands are terminated with <Enter>.

IMPORTANT: When you quit PC99, any unsaved work in progress is lost.

7.10. Debugger commands

This section lists each debugger command, the mode it can be used in, and a summary of use. The mode corresponds to the value entered after the "set debug mode" (sdm) command.

```
Dbg
Mode Cmd     Parameter      Usage

01234 ?      ............. Help - print command list
01234 c      ............. Continue with the program
01234 C      ............. Auto-continue without having to hit <Enter>
01234 cd     <drive number> Change disk file
...3. cf     <num> ........ Continue for <num> instructions and then stop
...3. dm     <C or Gn or R> <a1> <a2> <file> [FORCE] Dump memory to file
01234 dv     ............. Dump video memory to screen
01234 dwe    <drive number> Disk write enable (allow disk writes)
01234 dwp    <drive number> Disk write protect (disallow disk writes)
...3. e      ............. Edit mini-screen
...3. gploff ............. GPL opcodes - stop flagging fetches at PC >0078
...3. gplon  ............. GPL opcodes - start flagging fetches at PC >0078
01234 k      <duration>.... Set keystroke duration
.1.3. kboff  ............. Keyboard wheel off
.1.3. kbon   ............. Keyboard wheel on
01234 li     ............. Load interrupt
...3. mod    ............. Mini-screen objects - disable all
...3. moe    ............. Mini-screen objects - enable all
01234 Q      ............. Quit PC99 and return to DOS
...3. s      ............. Single step
...3. S      ............. Single step without having to hit <Enter>
...3. sca    <addr>........ Set CRU address - e.g. 1000 [1 = on, 0 = off]
01234 sd1    <percentage>.. Set processor delay 1 [0 = no delay]
01234 sd2    <percentage>.. Set processor delay 2 [0 = no delay]
01234 sdm    <mode>........ Set debug mode [0-4] ([0-2] for PC99A, PC99L).
...3. SMB    ............. Set Myarc bank
01234 soff   ............. Sound off
01234 son    ............. Sound on
01234 ssq    <num>......... Speech quality [1 = standard, 2 = enhanced]
...3. srb    <bank number>. Set RAM bank in cartridge space
...3. spr    ............. Sprite info
...3. spra   ............. Sprite attribute table
...3. sprc   ............. Sprite colors
...3. sprd   ............. Sprites draw
...3. spri   ............. Sprite intersector arrays
01234 ss     ............. Show status
...3. ton    <filename>.... Instruction trace on
...3. toff   ............. Instruction trace off
...3. tron   <filename>.... Instruction trace on
...3. troff  ............. Instruction trace off
01234 v      <int count>... Set maximum VDP interrupt counter
```

7.10.1. ?. Help - print command list

Prints a list of debugger commands. The commands available depend on the current debugger mode.

Example: to see the list of current commands.

```
? ?
```

7.10.2. c. Continue with the program

Example: You entered the debugger and want to return to the TI application.

```
? c
```

The TI application continues.

7.10.3. C. Auto-continue without having to hit <Enter>

Example: You entered the debugger and want to return to the TI application.

```
? C (no <Enter>)
```

The TI application continues.

7.10.4. cd. Change disk file

Example: Change DSK2 which is currently using C:\PC99\DSK\DSK2 to use the DOS file C:\PC99\DSK\TIBASE.DSK.

```
? cd 2
```

The screen is cleared and set to text mode and you are prompted with:

```
DOS filename for TI DSK2 ?
```

You now enter:

```
c:\pc99\dsk\tibase.dsk
```

Note: DOS filenames are not case sensitive.

The new disk is accessed. If successful you can return to the debugger prompt. If the file cannot be accessed, the old disk stays active and a warning is issued.

7.10.5. cf. Continue for <num> instructions and then stop

Example: You want PC99 to execute 200 (decimal) instructions and then break.

```
? cf 200
  Stopping on every multiple of 200 instructions
? c
```

PC99 will execute 200 instructions and then break.

To continue without breaking:

```
? cf 0
  Stopping on every multiple of 0 instructions
? c
```

7.10.6. dm. Dump memory to file

Allows you to dump selected sections of memory to a DOS disk file. The syntax is:

```
<C | R | Gn> <a1> <a2> <file> [FORCE]
```

where:

C	= CPU memory (>0000->FFFF)
Gn	= GROM bank number (0 - 15 decimal)
R	= ROM bank 1 (>6000->7FFF, TI bank switching)
a1	= low address
a2	= high address
file	= DOS filename to write
FORCE	= force overwrite of DOS file

Example: Dump GROM bank 0 from >0000 - >1FFF to disk. If the file \tmp\junk exists, then force the overwrite:

```
? dm G0 0 1FFF \tmp\junk FORCE
```

Example: Dump CPU memory from >2000 - >3FFF to disk.

```
? dm C 2000 3FFF \tmp\lowmem
```

7.10.7. dv. Dump video memory to screen

Shows the current state of the TI display. The screen is first drawn without sprites. Press any key to draw the sprites. Press any key to return to the debugger.

Example:

```
? dv
```

7.10.8. dwe. Disk write enable (allow disk writes)

Allows you to emulate removing a write-protect tab from a disk which allows the disk to be written to.

Example:

```
? dwe 2
```

The following confirmation appears:

```
DSK2 is now write enabled
Press <Enter> to continue
```

If the disk is write-protected by DOS:

```
DSK2 is DOS read only. Cannot write enable
Press <Enter> to continue
```

7.10.9. dwp. Disk write protect (disallow disk writes)

Allows you to emulate placing a write-protect tab on a disk which prevents the disk from being written to.

Example:

```
? dwp 2
```

The following confirmation appears:

```
DSK2 is now write protected
Press <Enter> to continue
```

If the disk is write-protected by DOS:

```
DSK2 is DOS read only. PC99 write protection skipped
Press <Enter> to continue
```

7.10.10. e. Edit mini-screen

The mini-screen debug mode places the PC monitor into VGA mode (640w x 480h x 256 colors). The upper left corner of the screen contains the TI screen (256w x 192h). The rest of the PC screen contains a series of editable objects.

An object consists of a title and editable fields. The title is displayed in color. If the title is red, the object will not be dynamically updated. If the title is green the object will be dynamically updated. An object's editable fields are usually displayed in white. [*Note*: These colors may have been changed with CFG.EXE.]

Press <e> at the debug prompt to enter the Mini-Screen editor:

```
? e

You are now editing the mini-screen. Hit <Esc> to finish.
```

The flashing Mini-Screen cursor will be displayed on the first object (PC [Program Counter]). You can move the cursor to any point on the screen by using the standard cursor keys. You can use the <Tab> and <Shift Tab> keys to move to the first field in the next or previous object. When in an object, <Home> will take you to the beginning of the current field.

To toggle an object from dynamic update to no dynamic update, or vice versa, move the cursor into the object and press <Enter>. The object title changes from green to red, or vice versa.

You can move the cursor to any editable field in an object and change the field value.

When you have finished editing the mini-screen press <Esc>. You are returned to the Debugger prompt. Press <c> to continue, or <s> to single step.

The following sections describe each editable object on the Mini-Screen:

7.10.10.1. Instruction Counters

The Total field contains the number of instructions executed since PC99 was started. The Meter field contains the number of instructions executed since it was zeroed.

You can zero the Meter field and then use it to count the number of instructions between selected events.

7.10.10.2. Int Req

This field is set to a 1 when a VDP interrupt is pending. You can edit this field to simulate a pending VDP interrupt, or clear one that is pending.

7.10.10.3. PC

The program counter (PC) contains the CPU memory address of the next instruction to be executed. The program counter should always be set to an even address.

7.10.10.4. WS

Contains the address of the CPU Workspace Pointer.

7.10.10.5. Status Register

This object represents the CPU Status Register:

Hex:
This four-digit field is a 16-bit representation of the Status Register.

L A E C O P X:
These fields are the most significant bits of the Status Register. The bits are: Logical greater than, Arithmetic greater than, Equal, Carry, Odd parity and Extended operation.

Mask:
This field is the interrupt mask contained in the four least significant bits of the Status Register.

7.10.10.6. Workspace Registers

The contents of the 16 workspace registers pointed to by the Workspace Pointer.

7.10.10.7. VDP Registers

The contents of the 8 VDP registers. These registers are described in the E/A manual, page 326.

7.10.10.8. VDP Info

Contains VDP information:

Disp:
Shows the status of the display (ON | OFF).

Mode:
Shows the VDP mode: (GRAFX | TEXT | MULTI | BIT)

Patn:
Shows the base address of the Pattern Descriptor Table (hex).

Scrn:
Shows the base address of the Screen Image Table (hex).

Colr:
Shows the base address of the Color Table (hex).

These fields are display only. To change them, you need to set values in the VDP registers.

Example: The display is OFF, and you want it on, and V1 contains >80. Edit V1 to contain >C0. This turns on bit 1, the blank enable/disable bit. One place to try this is during the power-up sequence.

7.10.10.9. VDP Status

This object represents the VDP status byte:

HX:
This two-digit field is an eight-bit representation of the VDP Status Byte.

I
This one-bit field is the VDP interrupt flag. It is set if a VDP interrupt has occurred.

5
This one-bit field is the five sprites flag. It is set if there are five or more sprites on a line.

C
This one-bit field is the sprite coincidence flag. Set if two or more sprites have overlapping pixels.

5-SprNum
This five-bit field is the fifth sprite number. This value is shown in binary and decimal.

7.10.10.10. IntCt

The top field shows the number of instructions that are executed before a VDP interrupt is simulated. The default for this value is set with CFG.EXE under System, Change System Variables, Change VDP Interrupt Count. The value in this field is editable and should be in the range 100-65000. The smaller the value of the VDP Interrupt Count, the more VDP interrupts occur in unit time.

You can also set this field by using the "z" command at the debugger prompt.

The bottom field shows the value of the counter, which counts down to zero from the value displayed in the top field. The value in this field is editable and should be in the range 100-65000. You can set this to be larger than the value in the top field and the countdown will continue from that value until it reaches zero. Then the value in the top field will be used for the next countdown.

7.10.10.11. PC Instr

The last n instructions executed displayed in disassembled format. The disassembly includes the instruction name, opcode, and source or destination fields.

You can scroll this object using the <Page Up> or <Page Down> keys.

You can go to a numbered line in the scroll stack by entering the line number in the three-digit field next to the object label. Your position in the stack is represented by a vertical bar to the left of the object.

If the mini-screen cursor is in the object, you can use + to toggle the display to show or hide the hex value of the instruction.

You can use = to resolve an indexed address.

7.10.10.12. Mini-screen breakpoints

Up to 15 breakpoints can be set in CPU, GROM or VDP memory. Breakpoints can be absolute or contain wild cards.

Example: Break when PC=02B2 is an absolute breakpoint. This tells PC99 to break when the Program Counter equals >02B2.

Example: Break when V1=C? is a wild card breakpoint. This tells PC99 to break when the most significant nybble or VDP Register 1 = >C. The contents of the least significant nybble can have any value.

When you place the mini-screen cursor on an empty breakpoint field, the following prompt is displayed:

Empty breakpoint. Enter: V (VDP), W (Workspace), G (GROM), C (CPU) or P (PC)

If you enter V, the following message is displayed:

```
Enter: R (Register), M (Memory), S (Status), Alt-D (delete)
```

v

r Display: VDP: R?=??

Enter a digit (0 - 7) following the R to select a VDP register, followed by a 2-digit hex value for the contents of the register. PC99 will break when the selected VDP register is set to the value.

Example: VDP: R1=C0

breaks when VDP R1 = >C0.

Example: VDP: R1=C?

breaks when the most significant nybble of VDP R1 = >C.

m Display: VDP:????=??

Enter a 4-digit VDP hex address (>0000 - >3FFF), followed by a two-digit hex value for the contents of the address. PC99 will break when the VDP address contains the value.

Example: VDP:0380=1F

breaks when VDP address >0380 = >1F.

Example: VDP:038?=1F

breaks when any VDP address in the range >0380->038F = >1F.

s Display: VDP: STAT=??

Enter a 2-digit hex value for the VDP Status Register. PC99 will break when the VDP Status Register contains the value.

Example: VDP: STAT=04

breaks when the VDP Status Register = >04.

If you enter W, the following message is displayed:

```
Enter: R (Register), S (Workspace Pointer), Alt-D (delete)
```

w

r Display: WS:R??=????

Enter a 2-digit decimal value (0 - 15) to select the Workspace Register, followed by a 4-digit hex value for the contents of the register. PC99 will break when the WS register contains the value.

Example: WS:R01=FFFF

breaks when Workspace Register R1=>FFFF

Example: WS:R15=8C??

breaks when the most significant byte of R15 = >8C.

s Display: WS:Ptr=????

Enter a 4-digit hex value. PC99 will break when the Workspace Pointer is set to the value.

Example: WS:Ptr=83E0

breaks when the Workspace Pointer = >83E0.

If you enter G, the following message is displayed:

```
Break at GROM memory address. Alt-D (delete)
```

g Display: G??:????=??

Enter a 2-digit decimal value to select the GROM bank, followed by a 4-digit GROM hex address, followed by a 2-digit hex value for the contents of the address. PC99 will break when the address in the selected GROM bank contains the value.

Example: G00:12B4=??

breaks when the GROM address >12B4 in GROM bank 0 is accessed.

If you enter C, the following message is displayed:

```
Break at CPU memory address. Alt-D (delete)
```

c Display: CPU:????=??

Enter a 4-digit hex value to select a CPU address, followed by a 2-digit hex value for the contents of the address. PC99 will break when the CPU address contains the value.

Example: CPU:A024=?F

breaks when the least significant nybble of CPU address >A024 = >F.

If you enter P, the following message is displayed:

```
Break at Program Counter. Alt-D (delete)
```

p Display: PC =????

Enter a 4-digit hex value. PC99 will break when the Program Counter is set to the value.

Example: PC =A05A

breaks when the Program Counter = >A05A.

To delete a breakpoint field press <Alt-D> (delete) with the cursor in the field.

7.10.10.13. Trace Select

Up to 12 trace-points can be set in CPU, GROM or VDP memory. Trace-points are absolute values — wild cards are not allowed.

When you place the mini-screen cursor on an empty trace-point field, the following prompt is displayed:

```
Enter: C (CPU), G (GROM), L (GPL), P (PC), S(Status), V (VDP), W (Workspace)
```

A trace-point can be enabled or disabled. The first character of an enabled trace-point is a hyphen (-). The first character of a disabled trace-point is an asterisk (*). You can toggle the state of a trace-point by placing the mini-screen cursor on the first character of the trace-point and pressing <*>.

c Display: -C MEM 0000

Enter a 4-digit hex value to select a CPU memory address. When the PC is set to that address, PC99 will push the address, it contents, and whether the operation was a read or write, on to the trace stack.

g Display: -GRM00:0000

Enter a 2-digit decimal (0-15) to select a GROM bank, followed by a 4-digit hex value to select a GROM address. PC99 will push the GROM bank, GROM address, it contents, and whether the operation was a read or write, on to the trace stack. (A write is normally illegal.)

l Display: -GPL opcode

The GPL interpreter code begins at CPU >0070. The opcode for the next GPL instruction is fetched at CPU >0078. If the Program Counter is at this address, PC99 assumes this code is fetching the next GPL opcode. This opcode is decoded and the opcode and its mnemonic are pushed on to the trace stack.

p Display: -PC

PC99 will push the Program Counter (PC) on to the trace stack. This will fill the stack very quickly, as the PC is changed on almost every instruction.

s Display: -Status Reg

PC99 will push the CPU Status Register on to the trace stack.

If you enter V, the following messages is displayed:

```
Enter: R (Register), M (Memory), S (Status), Alt-D (delete)
```

v

r Display: -VDP REG:0

Enter a digit (0 - 7) following the REG: to select a VDP register. PC99 will push the register, its contents, and whether the operation was a read or write, on to the trace stack. (A read is normally illegal.)

m Display: -V MEM 0000

Enter a 4-digit VDP hex address (>0000 - >3FFF). PC99 will push the VDP address, its contents, and whether the operation was a read or write, on to the trace stack.

s Display: -VDP STATUS

PC99 will push the VDP Status Register on to the trace stack.

If you enter W, the following message is displayed:

```
Enter: R (Register), S (Workspace Pointer), Alt-D (delete)
```

w

r -WS REG 00

Enter a 2-digit decimal value (0 - 15) to select the Workspace Register. PC99 will push the register, it contents, and whether the operation was a read or write, on to the trace stack.

s -WS POINTER

PC99 will push the Workspace Pointer on to the trace stack.

Example: Trace the values sent to the sound chip at address >8400 during the power-up sequence.

First return to the TI title screen.

Press <Esc> to enter the debugger, and then <e> to edit the mini-screen. Move the mini-screen cursor to the Trace Select object. Enter C, and 8400 for the address. Enable the Trace Select object and the Trace object (press <Enter> in the title of each object). Press <Esc> to return to the debugger prompt. Press <c> to continue.

Press <Alt-=> to return to the title screen. The values sent to the TMS9919 sound chip will be displayed in the Trace object. The display shows:

```
CPU8400w9f
```

This means that at CPU >8400 a write took place. The value written was >9F. This action turns off sound generator 1.

Example: Trace the GPL opcodes being executed.

First return to the title screen.

Press <Esc> to enter the debugger, and then <e> to edit the mini-screen. Move the mini-screen cursor to the Trace Select object. Enter L. Enable the Trace Select object and the Trace object (press <Enter> in the title of each object).

Press <Esc> to return to the debugger prompt. Press <c> to continue.

The Trace object will fill with the GPL opcodes being executed while waiting for a key press.

7.10.10.14. Sprites

Patn: This field contains the base address of the sprite pattern table.

Attr: This field contains the base address of the sprite attribute table.

7.10.10.15. VDPR

The field below the title contains the last value that the VDP RAM Write Address register (VDPWA or >8C02) was set to for a read to VDP.

The field below the address contains the last byte value read from VDPWA through the VDP RAM Read Data register (VDPRD or >8800).

7.10.10.16. VDPW

The field below the title contains the last value that the VDP RAM Write Address register (VDPWA or >8C02) was set to for a write to VDP.

The field below the address contains the last byte value written to VDPWA through the VDP RAM Write Data register (VDPWD or >8C00).

7.10.10.17. Grom:

This object displays values read from GROM.

Grom: This field contains the GROM bank number (0-15).

Addr: This field contains the last value that the GROM/GRAM Write Address register (GRMWA or >9C02) was set to for a read from GROM.

Value: This field contains the last byte value read from GRMWA through the GROM/GRAM Read Data register (GRMRD or >9800).

Note: The above values are for GROM bank 0. For each increment in the GROM bank value, add 4 to GRMWA and GRMRD.

Example:

If the GROM bank number is 2, then GRMRD is >9800 + (2 * 4) = >9808.

7.10.10.18. Mini-Screen memory objects

There are three mini-screen memory objects. In each memory object you can display the following kind of memory: AMS, CPU, GROM, Myarc and VDP. To select the kind of memory, place the mini-screen cursor after the y in "Memory". Enter:

a AMS card memory
Place the cursor on the three digits following the word "AMS" and enter a decimal value between 000 and 255 to select a 4K AMS bank.

c CPU memory

g GROM memory
Place the cursor on the two digits following the word "GROM" and enter a decimal value between 00 and 15 to select a GROM bank.

m Myarc 512K card memory
Place the cursor on the two digits following the word "Myar" and enter a decimal value between 00 and 15 to select a 32K Myarc bank.

v VDP memory

You select a memory address in the range >0000-FFFF by entering it in any row in the four-digit column below "Memory". For the AMS memory you can enter 5 digits in the range >00000-1FFFF.

You edit a memory object by placing the Mini-Screen cursor over a hex value field and entering a new value, or by placing the cursor over an ASCII value field and entering a new ASCII character.

You can scroll any memory object by placing the Mini-Screen cursor in the object and using the <Page Up> and <Page Down> keys.

You can search any memory object by entering values as hex or ASCII. You enter two-digit hex values in the 12 -- fields above the memory object. You enter ASCII values in the Asc: field. When you have entered the search values, you can search forward or back from the current base address in the window. Press <Alt-N> to find the N)ext occurrence of the search values in higher memory addresses. Press <Alt-P> to find the P)revious occurrence of the search values in lower memory addresses. If no matching values are found the message: "Desired bytes not found. (Hit Enter to continue)" is displayed.

7.10.10.19. AMS mapper

If the AMS card is the current memory peripheral, then in any memory object you can place the mini-screen cursor on the label (e.g. AMS or VDP), and press <->. This will shorten the memory object by two rows, and display the AMS mapper object at the bottom of the memory object.

The mapper display contains the following fields:

C CRU >1E00 has been set enabling the AMS card.
c CRU >1E00 is reset.

M CRU >1E02 has been set enabling the AMS mapping registers.
m CRU >1E02 is reset.

For each mapping register:

n:00=000=00000

n is the mapping register number (2, 3, A, B, C, D, E, F).
00 the bank number being mapped in hex (>00-FF).
000 the bank number being mapped in decimal (000-255).
00000 the base address of the mapped 4K chunk of memory (>00000-1F000).

You can edit the bank number field in either hex or decimal and the appropriate memory address will be set.

7.10.11. gploff. GPL opcodes - stop flagging fetches at PC >0078

Turns off flagging of GPL instructions.

Example:

```
? gploff
```

7.10.12. gplon. GPL opcodes - start flagging fetches at PC >0078

Turns on flagging of GPL instructions.

The GPL interpreter code begins at CPU >0070. The opcode for the next GPL instruction is fetched at CPU >0078. If the Program Counter is at this address, PC99 assumes this code is fetching the next GPL opcode.

This opcode is decoded and will be displayed in the PC Instr object interspersed with the 9900 assembly instructions. This allows you to see what 9900 instructions are being executed for a given GPL instruction.

Example: You want to enable GPL opcode flagging.

```
? gplon
```

7.10.13. k. Set keystroke duration

On the TI-99/4A a key press causes certain CRU lines to be set. When the key is released, the CRU lines are reset. If an application does not respond quickly enough, the key press is lost.

On the PC, up to 16 key presses are stored in the BIOS keyboard buffer. Since PC99 retrieves a key press from this buffer, the buffering would not mimic the actions of the 99/4A keyboard.

To overcome this, PC99 retrieves the first key press from the BIOS keyboard buffer, flushes the buffer, and holds the retrieved key as valid for a time estimated to correspond with the key action on the 4A. PC99 "ages" the key (keeps the emulated CRU lines set) by counting down a key age variable. When it reaches zero, the CRU lines are reset and the next key press is retrieved from the BIOS keyboard buffer.

In practice, a user should not notice any of this. However, key presses in some applications (e.g. Logo II) can be lost because of too-rapid aging. You can improve such an application by changing the Keystroke Duration value. The default value is 1500.

If you increase the value the emulated CRU lines will stay set for longer. You can see this by enabling Debug Mode 1 (? sdm 1), and watch the character on Row 3 stay there for longer before being erased.

If you decrease the value, the keyboard will appear more responsive, but some applications (e.g. Basic CALL KEY) may miss the key press.

The range of values recommended for this variable is 1000 through 5000.

Example: To improve the keyboard response in TI Logo II.

```
? k 4000
```

7.10.14. kboff. Keyboard wheel off

Example: To turn off the keyboard wheel.

```
? kboff
```

7.10.15. kbon. Keyboard wheel on

This is a one-character field that will display the ASCII characters /, -, \, and | in succession to the right and top of the TI screen. This field is changed each time the keyboard CRU lines are scanned, creating a spinning wheel. Unless an application turns off the keyboard scan, this is a fairly good indication that the application (and PC99) is not hung.

Example: To turn on the keyboard wheel.

```
? kbon
```

7.10.16. Load interrupt

This command will emulate the -LOAD function of the TMS9900 processor. When active, -LOAD causes the TMS9900 to initiate an interrupt sequence immediately following the instruction being executed. Memory location >FFFC is used to obtain the vector (WP and PC). The old PC, WP, and ST are loaded into the new workspace and the interrupt mask is set to 0000. Then, program execution resumes using the new PC, WP and Status Register.

WARNING: You must have a valid vector loaded for this command to work. If you issue the command with an invalid vector, you will almost certainly send the Program Counter to "never-never land" and attempt to execute invalid instructions. Any work in progress will probably be lost.

You can test the load interrupt with the following procedure:

1. Start PC99 with the Editor/Assembler cartridge. Display the E/A option screen.

2. Press <Esc>. At the debugger prompt:

   ```
   ?sdm 3
   ```

   to enter the mini-screen.

3. At the mini-screen prompt:

   ```
   Command?e
   ```

   to enter edit mode

4. In memory window 1 (nearest TI screen):

   Set the base address to >FFFC.

   Set memory addresses: >FFFC = >A020, >FFFE = >A000 .

   ```
   Mem  CPU . . .
   FFFC A0 20 A0 00 . . .
   ```

   This creates the -LOAD vector: WP = >A020, PC = >A000.

   If a load interrupt occurs, the processor will use >A020 for the new workspace, and execute the instruction at >A000.

5. In memory window 3 (bottom of mini-screen):

   Set the base address to >A000.

   Set memory addresses: >A000 = >1000, >A002 = >1000, >A004 = >0380

   ```
   Mem  CPU . . .
   A000 10 00 10 00 03 80 . . .
   ```

   The equivalent assembly language program starting at address >A000 is:

   ```
   A000  1000  NOP
   A002  1000  NOP
   A004  0380  RTWP
   ```

   This code will execute two NOPs and then a Return Workspace Pointer.

6. Press <Esc> to exit editing.

7. At the mini-screen prompt:

   ```
   Command?c
   ```

   to continue. Normal program execution continues.

8. Press <Esc>.

9. At the mini-screen prompt:

   ```
   Command?li
   ```

   Enable a load interrupt to occur on the next instruction.

10. The message:

    ```
    Load interrupt enabled. WP = nnnn, PC = nnnn, <Enter> to continue.
    ```

    is displayed.

    This retrieves the new WP and PC from >FFFC and >FFFE respectively. The values should be WP = >A020 and PC = >A000.

    When using this command, you should ensure the WP and PC values are legitimate.

11. Press <Enter> to return to the mini-screen prompt.

12. At the mini-screen prompt:

    ```
    Command?s
    ```

    to single step. The last TI instruction will complete.

13. At the mini-screen prompt:

    ```
    Command?s
    ```

    and see the PC and WP change to the values above, and the instruction NOP execute at >A000.

14. Note that in memory window 3:

    Address >A03A = R13.
    This contains the saved WP. The value is >83E0, the GPL workspace used by the E/A.

Address >A03C = R14
This contain the saved PC, the addres of the last instruction executed. This will be somewhere in the TI ROM (>0000->1FFF), most likely in the keyboard scan routine.

Address >A03E = R15
This contains the saved Status Register.

15. At the mini-screen prompt:

```
Command?s
Command?s
```

to single-step to the RTWP instruction.

16. At the mini-screen prompt:

```
Command?s
```

to single-step once more and execution will resume at the address after the saved last instruction before the load interrupt was issued.

For normal use, a user-written program is loaded in memory, the load vector is set to point to the program entry point, and then the load interrupt command can be issued.

7.10.17. mod. Mini-screen objects - disable all

Example: To disable all mini-screen objects.

```
? mod
```

The titles of all enabled objects change color to their disabled state.

7.10.18. moe. Mini-screen objects - enable all

Example: To enable all mini-screen objects.

```
? moe
```

The titles of all disabled objects change color to their enabled state. Since each object has to be dynamically updated, PC99 will run relatively slowly.

7.10.19. Q. Quit PC99 and return to DOS

Example:

```
? Q
```

PC99 exits and the DOS prompt is displayed. All data in TI memory is lost.

7.10.20. s. Single step

PC99 will execute one TI instruction and then return to the debugger command prompt.

Example:

```
? s
```

All Mini-Screen objects are updated.

7.10.21. S. Single step without having to press <Enter>

PC99 will execute one TI instruction and then return to the debugger command prompt.

Example:

```
? S (no <Enter>)
```

All Mini-Screen objects are updated.

7.10.22. sca. Set CRU address - e.g. 1100

The address space >4000->5FFF is reserved for ROMs in peripheral cards. A ROM is paged into the address space by turning on the peripheral's CRU base address. The supported peripheral base addresses are: >1000, >1100, >1300, >1B00, >1F00.

Example: To set the CRU address to 1100 (Disk Controller). Edit one of the memory objects and set its base address to >4000. Unless a peripheral was actually being accessed when you entered the debugger, this area will normally show all >00 bytes. To see the contents of the disk controller ROM:

```
? sca 1100
```

The memory window will now fill with the contents of the disk controller ROM.

Note: If a peripheral type is set to "none", its ROM is not available, and the display will show all >00.

7.10.23. sd1. Set processor delay 1 [0 = no delay]
7.10.24. sd2. Set processor delay 2 [0 = no delay]

These values are used to call the FastGraph routine fg_stall. fg_stall delays a program's execution by a given number of processor-specific delay units. This delay occurs between each emulated TI instruction.

Delay value 1 and delay value 2 are combined and the total represents the number of times fg_stall is called.

Example: you want to slow PC99 down:

```
> sd1 50
> sd2 20
```

These values are cumulative and will call fg_stall 70 times between each emulated TI instruction.

7.10.25. sdm. Set debug mode [0-4] ([0-2] for PC99A, PC99L)

Example: To set the Debug Mode to 1 (peripheral and status information on right).

```
? sdm 1
```

7.10.26. smb. Set Myarc bank

Sets the bank number for the Myarc 512K card. This card has 16 32K banks which are bank-switched into the TI 32K memory space.

Example: you want to examine the contents of Myarc bank 4.

```
? smb 4
```

7.10.27. soff. Sound off

Immediately stops any sound being played on the PC speaker or Sound Blaster (or compatible). Any new TI sounds will not be heard.

Example: To turn sound off.

```
? soff
```

7.10.28. son. Sound on

If you have configured sound to be played on the PC speaker, then sound sent to TI sound generator 1 will be played on the PC speaker.

If you have configured sound to be played on a Sound Blaster (or compatible), then sounds sent to TI sound generators 1, 2 and 3 will be played on the Sound Blaster (or compatible).

Example: Sound has been turned off and you want to turn sound on.

```
? son
```

7.10.29. srb. Set RAM bank in cartridge space

Some cartridges have two banks of RAM/ROM at CPU addresses >6000->7FFF. You can display the contents of a selected bank in one of the memory windows.

Example: Extended Basic is a bank-switched cartridge. To display the contents of RAM bank 1.

```
? srb 1
```

Now go to a memory window and set the base address to >6000.

7.10.30. spr. Sprite info

For each of the 32 sprites (0 through 31) displays the following information: sprite number, status, color, height, width, dxmin, dymin, sxmin and symin.

7.10.31. spra. Sprite attribute table

For each of the 32 sprites (0 through 31) displays the following information: sprite number, y position, x position, name (pattern code), early clock/color, address in attribute table, and pattern number used by sprite.

7.10.32. sprc. Sprite colors

For each of the 32 sprites (0 through 31) displays the sprite number and corresponding sprite color (0 through 15).

7.10.33. sprd. Sprites draw

Each of the 32 sprites (0 through 31) is displayed graphically in color. On the first pass the sprites are drawn from the VDP tables. Press <Enter> and the sprites are drawn from the internal structures used by PC99 to maintain sprites. The two displays should be the same. This command allows you to see which sprites an application uses. Unused sprites will have random patterns.

7.10.34. spri. Sprite intersector arrays

Displays the contents of the PC99 sprite intersector arrays (192 x 256 pixels). For each of the 192 vertical rows (0 through 191) the column value is shown together with the number of coincidences on the row. If two sprites each have an overlapping on pixel (intersection) there is a coincidence.

7.10.35. ss. Show status

A typical display is:

```
RS232/1 = PC COM1, irq 4, address 0x03f8
RS232/2 not mapped to PC COM port
PIO/1 = PC LPT1, irq 7, address 0x0378
Delay value 1 = 0
Delay value 2 = 0
Speech quality = 1
Press <Enter> to continue
```

7.10.36. ssq. Set speech quality

1 = Standard. This matches the quality of the Speech Synthesizer as delivered with the 99/4A.
2 = Enhanced. This uses alogrithms that were in development but were not released with the 99/4A.

Ex: you want to use enhanced speech quality

```
? ssq 2
```

7.10.37. toff. Instruction trace off
7.10.38. ton. Instruction trace on

Allows you to trace every instruction executed. WARNING: This command can quickly create large files on your hard drive.

Example: You have reached a point in an application and want to trace the instructions being executed.

```
? ton \tmp\junk
```

Every CPU instruction being executed will be written to the file showing instruction number, memory address, hex value of CPU instruction, and disassembled instruction.

Example: To turn the trace off.

```
? toff
```

7.10.39. troff. Instruction trace off
7.10.40. tron. Instruction trace on

Allows you to trace every instruction executed and create a file which can be played back. WARNING: This command can quickly create large files on your hard drive.

Example: You have reached a point in an application and want to record the instructions being executed.

```
? tron \tmp\junk
```

Every CPU instruction being executed will be written to the file showing instruction number, memory address, hex value of CPU instruction, and disassembled instruction.

Example: To turn the trace off.

```
? troff
```

7.10.41. v. Set maximum VDP interrupt counter

PC99 simulates a VDP interrupt when its VDP interrupt counter reaches zero. You can increase or decrease the number of VDP interrupts in a given time. This may improve performance with some applications.

Example:

```
? v 1300
```

A VDP interrupt will occur every 1300 TI instructions.

8. PC99 utility programs

8.1. Using Read Sector and Write Sector to transfer disks

Your PC99 package includes utility programs to transfer disks between PC99 and a TI-99/4A in both directions using a serial line. The requirements are:

- A TI-99/4A system with disk controller, at least one disk drive, an RS232 card, and the Editor/Assembler or Extended Basic module. With a TI Disk Controller you can transfer up to DSSD (720 sectors). With a Myarc Disk Controller you can transfer up to DSDD (1440 sectors).
- The PC99 utility disk for the TI-99/4A.
- A PC with PC99 installed and at least one COM port.
- A "straight-through" cable to connect the TI RS232 port to the PC COM port. You can use a standard PC cable usually described as "AT modem" cable. *Note*: A PC "null modem" cable will not work. The section "Connecting devices to the PC COM port" shows the pinouts of the cable.

During installation of PC99, a copy of the TI "PC99 utility disk", is stored in the file PC99.DSK in \PC99\DSK. This disk contains the utility programs Read Sector, and Write Sector.

- Read Sector will read a TI disk sector by sector, and write groups of 32 sectors at a time in 8K PROGRAM file format to a serial port, or to another disk.
- Write Sector will read the 8K PROGRAM file format from a serial port or another disk and re-create them as sectors on a TI disk.

Note: Both of these utilities are TI programs. They run either on a 4A, or under PC99.

Using Read Sector and Write Sector you can send disks in either direction: from a 4A to PC99, or from PC99 to a 4A. Depending on the direction you are sending, one system must run Read Sector, and the other must run Write Sector.

Direction:	**On 4A run:**	**On PC99 run:**
From 4A to PC99	Read Sector	Write Sector
From PC99 to 4A	Write Sector	Read Sector

The Read Sector and Write Sector programs are supplied in E/A3 and E/A5 format. They can be loaded through the Extended Basic program SECTLOAD_X, which then allows you to choose Read Sector or Write Sector, or directly through the Editor/Assembler.

Utility:	**E/A5 name**	**XB Name**
Read Sector	DSKn.RSECTOR	DSKn.SECTLOAD_X
Write Sector	DSKn.WSECTOR	DSKn.SECTLOAD_X

8.1.1. Read Sector/Write Sector example.

This following example assumes you are transferring from TI RS232/1 to PC99 RS232/1 on COM1 and that the two ports are cabled together.

To transfer a disk from a 4A to PC99:

- On the 4A:
  Editor/Assembler
  Insert PC99 disk in DSKn. From E/A5 load DSKn.RSECTOR.

  Extended Basic
  Insert PC99 disk in DSK1. From XB do OLD DSK1.SECTLOAD_X and then RUN. Tell SECTLOAD_X you want to run Read Sector.

- On the 4A: Insert the disk you want to transfer in a drive. For a TI controller the disk must be SSSD or DSSD. For the Myarc controller the disk can be SSSD, DSSD, or DSDD.

- On the 4A: At the RSECTOR prompt "Source = DSK1", press <Enter> to accept the default, or edit the "1" and enter 1, 2, 3 or 4 to tell RSECTOR the source drive number (the drive number with the disk you want to transfer). RSECTOR will read the disk, display the name, and determine the number of sectors to transfer (SSSD = 360, DSSD = 720, DSDD = 1440).

- On the 4A: At the RSECTOR prompt: "Destination = RS232.BA=9600" press <Enter> to accept the default, or edit the field.

- On the PC: Assume you are going to copy the 4A disk to DSK2. First cd to \PC99\DSK and save your DSK1 and DSK2 files if necessary.

- On the PC: In \PC99\DSK
  > copy pc99.dsk dsk1
  This is the disk you will use to load the WSECTOR utility from under PC99.

- On the PC:
  If copying a DSSD disk:
  > copy fmt21.dsk dsk2
  If copying a DSDD disk:
  > copy fmt22.dsk dsk2
  This ensures you have a blank disk of matching size for the target.

- On the PC: Load PC99 with the Editor/Assembler, since it is faster than using Extended Basic. From E/A5 load DSK1.WSECTOR.

- On the PC: At the WSECTOR prompt "Source = RS232.BA=9600" press <Enter> to accept the default, or edit the field.

- On the PC: At the WSECTOR prompt: "Destination = DSK1", edit the default "1" and enter "2". WSECTOR will display the disk name and determine the number of sectors to write (SSSD = 360, DSSD = 720, DSDD = 1440).

- On both systems: The number 255 will appear at the top of both screens, and then start counting down from 32. Progress reports will be displayed on each screen until the transfer is complete. On both systems you can press R to restart and copy another disk, or FCTN= to quit to the title screen.

On the PC, you can now load and run the programs on the transferred disk in DSK2. When you exit PC99 you should now save the transferred disk:

```
> c:
> cd \pc99\dsk
> copy dsk2 {dosname}.dsk
```

where {dosname} is any name you want up to 8 characters (e.g. EAGAMES9.DSK).

In similar fashion, you can transfer a "disk" from your PC to a 4A.

Note: You should start Read Sector (the sending program) before Write Sector (the receiving program). If you start the receiving program first, there can be a delay before the emulated TMS9902 times out.

Note: If you are transferring from the 4A to the PC, and the PC WSECTOR displays 233 instead of 255, press <Esc> and <Shift-Q> to exit PC99. Then restart PC99 and go through the process of loading WSECTOR again.

8.2. Using PC Transfer to transfer disks (DSKMERGE.EXE)

This method only allows you to transfer disks from a 4A to PC99. The requirements are:

- A TI-99/4A system with DSDD disk controller such as the Myarc or CorComp controller, at least two disk drives, 32K expansion RAM, and the Editor/Assembler.
- A PC with PC99 installed and a 5.25" disk drive capable of reading and formatting 360K PC floppies.
- The program PC Transfer written by Mike Dodd, and the PC Transfer utilities disk.

8.2.1. PC Transfer example

This example assumes you are using DSK1 and DSK2 on the 4A.

- On the 4A: Format a disk to contain more than 720 sectors. If you use the Myarc Disk Manager, format the disk to DSDD (1440 sectors). If you use TI Disk Manager 2, format the disk to DSDD (1280 sectors). For this example this DSDD formatted disk is called the TI Transfer Disk.
- On the PC: Use DOS to format a 5.25" PC disk to DSDD (360K). It is not recommended to try and format the PC disk on the 4A system using PC-Transfer.
- On the 4A: Insert the TI "PC99 Utility disk" in DSK1. From E/A5 load DSK1.RSECTOR. Do not enter any information at the RSECTOR prompt.
- On the 4A: Insert the disk you wish to transfer to PC99 in DSK1. For maximum efficiency this should be a 720K disk (DSSD).
- On the 4A: Insert the TI Transfer Disk in DSK2.
- On the 4A: Tell RSECTOR that the source drive is 1 (DSK1), that the destination filename is DSK2.SA, that the destination is not a serial port, and that you are transferring a 720K disk. RSECTOR will then convert groups of 32 sectors from DSK1 into 8K PROGRAM files on DSK2. Successive files will be named SA, SB, SC, SD. . . (Only the last file will have less than 32 sectors).
- On the 4A: Load PC-Transfer and the TIFILES option.
- On the 4A: Insert the TI Transfer Disk in DSK1 and the formatted DOS disk in DSK2.
- On the 4A: Using PC-Transfer, list the TI directory. There will be a series of files named SA through SW. For each file use PC-Transfer to name the DOS files as SA through SW.
- When the transfer is complete move the DOS disk to the PC.

- On the PC: Ensure that the file \PC99\UTIL\STRIP.BAT contains the necessary commands to process the file. A sample listing is shown below:

```
echo "stripping..."
gstrip a:\sa  c:\tmp\sa 128
gstrip a:\sb  c:\tmp\sb 128
...
gstrip a:\sv  c:\tmp\sv 128
gstrip a:\sw  c:\tmp\sw 128
```

  The batch file repeatedly calls the PC99 utility GSTRIP.EXE. The syntax for GSTRIP.EXE is:

  gstrip <input file> <output file> <number of bytes to strip>

  In this example, GSTRIP.EXE reads from the PC floppy in A: and writes to the PC C:\TMP directory and strips 128 bytes from each input file. These 128 bytes were added to the file by the TIFILES option of PC-Transfer.

  At the DOS prompt execute STRIP.BAT:

```
> cd \pc99\util
> strip
```

  The batch file will create a series of files (SA, SB, SC. . .) in the \TMP directory on your hard disk.

- Run the DSKMERGE utility to create a PC99 emulated disk file from the transferred files:

```
> cd \pc99\dskutil
> dskmerge c:\tmp\s c:\pc99\dsk\fmt21.dsk c:\tmp\mydisk.dsk
```

  Note that the s in the second argument (c:\tmp\s) is the basename for the files SA through SW. DSKMERGE.EXE uses this argument to find each file by appending an incrementing ASCII character starting with A.

You can now use MYDISK.DSK in PC99. If you want to use this as DSK1, first save the current \PC99\DSK\DSK1. You can then copy MYDISK.DSK to \PC99\DSK\DSK1.

8.3. Checking a PC99 disk (DSKCHECK.EXE)

Use DSKCHECK.EXE, a program that lives in \PC99\DSKUTIL, to check an emulated disk file. The syntax is:

```
dskcheck <TI dsk file to check> <DOS log file>
```

Example:

```
> cd \pc99\dskutil
> dskcheck c:\pc99\dsk\dsk1 c:\tmp\dsk.log
```

DSKCHECK.EXE will display its progress and record any errors or problems in the file C:\TMP\DSK.LOG. You can examine the log file with an ASCII editor. It contains a complete dump of the disk in hex and ASCII.

The dump is in the order of the data on the disk and includes checks of the inter-sector data. Sectors are in interleave order. To dump the disk in sector order use DSKDUMP.EXE.

The log file is large (over 1Mb). You will want to erase it when done to conserve hard disk space.

8.4. Cataloging a PC99 disk (DSKDIR.EXE)

Use DSKDIR.EXE, a program that lives in \PC99\DSKUTIL, to catalog an emulated disk file from DOS. The syntax is:

```
dskdir <TI dsk file> [/switches]
```

Without any switches, DSKDIR.EXE will display sector 0 and file information about the disk in a format similar to that of the TI disk manager.

/b DSKDIR.EXE will display sector 0 information in "byte" format. The header bytes are displayed according to their use and show values in hex, decimal and ASCII where appropriate.

Example:
```
> c:
> cd \pc99\dsk
> ..\dskutil\dskdir dsk1 /b
```

/d DSKDIR.EXE will display file information only, in a format similar to the TI Disk Manager.

Example:
```
> c:
> cd \pc99\dsk
> ..\dskutil\dskdir dsk1 /d
```

/f DSKDIR.EXE will display filenames only.

Example:
```
> c:
> cd \pc99\dsk
> ..\dskutil\dskdir dsk1 /f
```

/h Must be used with another switch, typically /d. This suppresses the header line above the directory listing, and is designed to be used when listing multiple disks so that the output can be combined and sorted when building a library of program names.

Example:
```
> c:
> cd \pc99\dsk
> ..\dskutil\dskdir dsk1 /d /h
```

/m DSKDIR.EXE will display a map showing used (≡) and unused (·) sectors. The size of the map depends on whether the disk is SSSD, DSSD or DSDD.

Example:
```
> c:
> cd \pc99\dsk
> ..\dskutil\dskdir dsk1 /m
```

/n DSKDIR.EXE will display filenames followed by the disk name. This can be used to build a file containing filenames from many disks and then sorting them.

Example:
```
> c:
> cd \pc99\dsk
> ..\dskutil\dskdir dsk1 /n > \tmp\junk
> ..\dskutil\dskdir dsk2 /n >> \tmp\junk
> ..\dskutil\dskdir dsk3 /n >> \tmp\junk
> sort < \tmp\junk > \tmp\junk.srt
```

/o DSKDIR.EXE will display all the filenames on a Plato disk. This switch must be used with /d, /f or /n and will only work with a Plato disk.

Example:
```
> c:
> cd \pc99\dsk
> ..\dskutil\dskdir phd52502.dsk /d /o
```

/p DSKDIR.EXE will display p-System files, including size, date, block start, and block end. This flag should only be used on a p-System disk which has been Z(ero'ed by the p-System Filer.

Example:
```
> c:
> cd \pc99\dsk
> ..\dskutil\dskdir dsk1 /p
```

/s DSKDIR.EXE will display sector 0 information only.

Example:
```
> c:
> cd \pc99\dsk
> ..\dskutil\dskdir dsk1 /s
```

/v DSKDIR.EXE will print its ID.

Note: You may wish to copy DSKDIR.EXE to the \PC99\DSK directory. This saves you having to type full pathnames when you catalog a disk.

8.5. Dumping a PC99 disk (DSKDUMP.EXE)

Use DSKDUMP.EXE, a program that lives in \PC99\DSKUTIL, to dump the data in an emulated disk file to a DOS file. The syntax is:

```
dskdump <TI dsk file> <DOS outfile> <start sector> <end sector>
```

<start sector> and <end sector> are decimal values in the range:

SSSD	0	359
DSSD	0	719
DSDD	0	1439

The DOS outfile is a combination hex and ASCII dump in numerical sector order.

Example:

```
> cd \pc99\dskutil
> dskdump c:\pc99\dsk\dsk1 c:\tmp\dsk1.dmp 0 719
```

DSKDUMP.EXE will read the emulated TI disk file DSK1, and create a dump file DSK1.DMP. Sectors 0 through 719 will be dumped.

8.6. Finding a TI filename (DSKFIND.EXE)

Use DSKFIND.EXE, a program that finds (searches for) a disk manager filename using a wildcard selection of disk files. The syntax is:

```
dskfind <ti filename to find> <ti dsk file list> [/switches]
```

Example:
```
> cd \pc99\dsk
> \pc99\dskutil\dskfind load *.dsk
```

DSKFIND.EXE will search for a TI file called LOAD in every disk in the current directory. For each match, the filename and disk name is displayed.

If <ti filename to find> is . (period) then all files are considered a match. You can use this to build a library of filenames by disk name.

Example:
```
> cd \pc99\dsk
> \pc99\dskutil\dskfind . *.dsk
```

will find all filenames on all disks.

The following switches can be used:

/f TI filenames are usually in upper case (caps). By default, DSKFIND.EXE will convert the TI filename to upper case. You can override this by the /f switch.

Example:
```
> cd \pc99\dsk
> \pc99\dskutil\dskfind Load *.dsk /f
```

will only find TI files named "Load". "LOAD" will not be a match.

/m The filename is used as a partial match on the first characters of any filename. A filename of "load" will find "LOAD", "LOADPRINT", "LOADLOCAL",...

Example:
```
> cd \pc99\dsk
> \pc99\dskutil\dskfind load *.dsk /m
```

/s Appends a summary of the results to the display.

Example:

```
> cd \pc99\dsk
> \pc99\dskutil\dskfind load *.dsk /s
```

will show all matching files, followed by:

```
Disks searched = nn
Files checked  = nnn
Matches found  = nn
```

/t Usually used with the -m switch. Displays whether the match was exact or partial.

Example:

```
> cd \pc99\dsk
> \pc99\dskutil\dskfind load telco.dsk /m /t

LOAD        -- TELCO.DSK            -- exact match
LOADPRINT   -- TELCO.DSK            -- partial match
```

/v Verbose mode. Displays the program title, the find string, and the filename being processed.

Example:

```
> cd \pc99\dsk
> \pc99\dskutil\dskfind load telco.dsk /m /v

dskfind. v1.1. 30-aug-95
Searching for: LOAD
Processing: TELCO.DSK
LOAD
LOADPRINT
```

Note: Since you will usually use DSKFIND.EXE in the \PC99\DSK directory, you might find it more convenient to copy the program there to save having to type the path each time.

Example:

```
> copy c:\pc99\dskutil\dskfind.exe c:\pc99\dsk
```

8.7. Renaming a PC99 disk (DSKNAME.EXE)

Use DSKNAME.EXE, a program that lives in \PC99\DSKUTIL, to change the TI name of a PC99 disk. This name is the TI disk name, as displayed by the TI Disk Manager, not the name of the file in DOS. The syntax is:

```
dskname <TI dsk file> <new TI disk name>
```

Example:

```
> cd \pc99\dskutil
> dskname ..\dsk\test.dsk NEWTEST
```

DSKNAME.EXE will read the TI disk file test.dsk and rewrite it to the same name with the new TI disk name. When test.dsk is cataloged with the TI Disk Manager or with DSKDIR.EXE, the TI disk name will be NEWTEST.

8.8. Extracting a TI file (DSKOUT.EXE)

All the files on a TI disk are stored in a single DOS file, such as \PC99\DSK\DSK1. The information in this DOS file is structured in a format representing the physical TI disk. This structure includes TI sectors 0 and 1, the TI File Descriptor Records (FDRs), and the TI files themselves. The TI files can also be fractured and are not necessarily in contiguous order in the DOS file. In addition, the DOS file contains all the TI disk inter-sector information.

You can extract any TI file from an emulated TI disk and store it as a standalone DOS file. You use the DSKOUT.EXE program to do this. DSKOUT.EXE needs to know the name of the TI emulated disk file, the name of the TI file to extract, and the name of the DOS file to create.

The syntax is:

```
dskout <TI emulated disk file> <TI filename> <DOS filename> {override}
```

Example: To extract from DSK1 the TI file BLACKBOX_X and create the DOS file BLACKBOX.OUT.

```
> c:
> cd \pc99\dskutil
> dskout c:\pc99\dsk\dsk1 blackbox_x \tmp\blackbox.out
```

By default, dskout will use the Disk Manager method of searching for file names. This method assumes that two consecutive >00 bytes in sector 1 means there are no more files on the disk. Some protection schemes take advantage of this. You can force dskout to keep searching sector 1 and therefore possible FDRs by setting an override value. This cannot be larger than 127. Note that the override can produce unexpected results, and is only useful in special circumstances.

8.8.1. DSKOUT format.

The first 256 bytes of the DSKOUT file contain the 256 bytes from the FDR corresponding to the TI file. This is followed by 256-byte records containing the contiguous sectors of the TI file. DSKOUT stores the FDR to allow other PC applications to determine the type of file extracted. The type could be PROGRAM, DIS/FIX 80, INT/VAR 254, and so on.

The file extracted by DSKOUT is of little use in itself. The file is designed to be used as input to another DOS application. For example, if you extract a TI Basic PROGRAM file, the extracted data will be in TI internal token format. If you wanted to try and run the TI Basic program using the PC's Qbasic, you would need a way of converting the TI internal format to a format acceptable to Qbasic.

The following conversion utilities for use with DSKOUT.EXE are supplied with PC99:

8.8.2. BAS2ASC.EXE

Takes an extracted TI Basic or Extended Basic PROGRAM file and converts to ASCII. The output is similar to LISTing a TI Basic program. The converted file can be loaded into PC Basic. [Not all TI Basic statements are valid in PC Basic.] The syntax for BAS2ASC is:

```
> bas2asc <input file> <output file> {/a}
```

<input file> is the name of the file created by DSKOUT.EXE. <output file> is the ASCII output of BAS2ASC.EXE. The optional /a switch will dump all information. This includes the line number table and the bytes that make up each Basic line.

Example: You have a TI Basic file called TEST_B on a TI disk called TESTDISK.DSK.

```
> c:
> cd \pc99
> dskutil\dskout dsk\testdisk.dsk test_b \tmp\test.out
> dskutil\bas2asc \tmp\test.out \tmp\test.bas
```

The file \TMP\TEST.BAS is the ASCII version of the TI Basic program file TEST_B.

8.8.3. DV802ASC.EXE

Takes an extracted DIS/VAR 80 file and converts to ASCII. The output can be opened by an ASCII editor. In addition, many word processing programs, such as WordPerfect, can import ASCII files. The syntax for DV802ASC.EXE is:

```
> dv802asc <input file> <output file> [mode]
```

<input file> is the name of the file created by DSKOUT.EXE. <output file> is the ASCII output of DV802ASC.EXE.

[mode] can be 0-4:

mode 0: characters less than 0x20 and greater than 0x7f are not output. Non-ASCII characters are therefore not output. All characters output will be in the ASCII range 0x20 through 0x7f. If no mode is specified, then mode 0 is used.

mode 1: all characters are output. Non-ASCII characters are output as <nn>.

mode 2: characters less than 0x20 are not output. Non-ASCII characters are output as <nn>.

mode 3: characters greater than 0x7f are not output. Non-ASCII characters are output as <nn>.

mode 4: characters less than 0x20 are not output, except for 0x09 (tab). Non-ASCII characters are output as <nn>.

This utility allows you to exchange files between TI-Writer and a PC word processor, such as WordPerfect. To load the converted file into WordPerfect:

```
> wp <output file>
```

WordPerfect will report "Document conversion in progress. . .", and then display the file.

In WordPerfect for Windows, use the File menu to Open the file. A dialog box will display saying the file is in ASCII format. Click OK, and it will be imported.

8.8.4. DIS.EXE.

Disassembles E/A5 files and E/A5 files that have been "joined" by EA5JOIN.EXE. If you have an E/A5 program that consists of more than one program file (for example, TELCO, TELCP, TELCQ), use EA5JOIN.EXE to create a single file from these. You can then use DIS.EXE to disassemble the complete program.

The syntax for DIS.EXE is:

```
> dis <file to disassemble> <base addr> <outfile> <ctl file> [dataflag]
```

<file to disassemble> can be a single E/A5 file, or the output of EA5JOIN.EXE.

<base addr> is usually >A000, but can be set to any value you want. <base addr> should match the value in the file being disassembled. This value can be found in the first (or only) file you extracted with DSKOUT.EXE at offset >0104 and >0105. For example, in the program River Raid from Thorn EMI, the two extracted files are RIVERRES_1 and RIVERRES_2. The first extracted file is RIVERRES_1. If you use DUMP.EXE on RIVERRES_1, you will find the values >CF and >F8 at offset >0104 and >0105. This means the <base addr> for this program is >CFF8.

<outfile> is the name of the disassembled file.

<ctl file> is the control file, usually DIS.CTL. This is an ASCII file with a single four-digit hex address, or a four-digit hex address pair, per line. This tells DIS.EXE to treat these addresses as DATA. For example, if DIS.CTL contains:

```
a000
a012
a020-a02f
...
```

The first two lines, A000 and A012, tell DIS.EXE not to disassemble the contents of >A000 and >A012, but to label them as DATA. The third line tells DIS.EXE not to disassemble the contents of >A020 through >A02F, but to label them as DATA. The range separator must be a hyphen. After a first pass of DIS.EXE, you can start to deduce which areas of the program are DATA and not code. You can then update DIS.CTL and run DIS.EXE again.

Note: Each line in DIS.CTL must contain a value or a range. Use an ASCII editor to ensure there are no blank lines at the end of the DIS.CTL file.

[dataflag] can be set with a "1". If dataflag is omitted or not set (the default) then DIS.EXE applies the following rules in trying to determine DATA:

> LIMI statements of the form LIMI 0, LIMI 1, and LIMI 2. These are the only values normally used in the 4A world. If any other value is found after the LIMI, then DIS.EXE assumes the LIMI word and the word following are DATA statements.
>
> LWPI statements that have an immediate value of less than >2000. It is unlikely that any 4A program would do this, since this would put the workspace in the console ROM.

If you do not want these DATA rules applied, you can override the dataflag defaults by setting the dataflag.

DIS.EXE will label each kind of DATA statement it generates:

nop: a word that has no legal opcode.

ctl: a word at an address in the control file.

lim: the word after a LIMI statement is greater than >0002. Both the LIMI statement and the word following are flagged as DATA.

lwpi: the word after a LWPI statement is less than >2000. Both the LWPI statement and the word following are flagged as DATA.

DIS.EXE makes a first pass through the input file and collects the targets of B, BL and BLWP statements. DIS.EXE writes a temporary file called __DIS.TMP. This file is then opened and re-processed which allows DIS.EXE to label locations which have been pointed to by Branch (B) and Branch and Link (BL) instructions. This helps to identify subroutines in the disassembled code. In addition, DIS.EXE flags all transfer vectors used by a Branch and Load Workspace Pointer (BLWP) statement.

The output of DIS.EXE is an ASCII file. You can open the file with an ASCII editor, and examine it. You can print the file to help analyze the program. To save paper, you can open the file with a word processor, such as WordPerfect, and columnize and paginate it before printing.

8.8.5. EA5JOIN.EXE.

Loads successive E/A5 files into an equivalent TI memory space and saves as a single file. The output file can be used by the PC99 disassembler, DIS.EXE. The syntax for EA5JOIN.EXE is:

```
> ea5join <filenames to join...>
```

Example:

```
> ea5join telco telcp telcq
```

The output file is hard-coded to be ea5.out.

8.8.6. EAC2ASC.EXE

Converts E/A3 compressed format files to ASCII. Shows all tags by name, the load offset, and contents in hex and ASCII. This program is useful for exploring E/A3 compressed files. It shows a partial disassembly of the file, along with offset, contents, and ASCII values of each location. In addition it shows all REFs and DEFs, and the program entry point.

The syntax for EAC2ASC.EXE is:

```
> eac2asc <infile> <outfile>
```

<outfile> can be read by an ASCII editor.

8.8.7. EAU2ASC.EXE

Converts E/A3 uncompressed format files to ASCII. Shows all tags by name, the load offset, and contents in hex and ASCII. This program is useful for exploring E/A3 uncompressed files. It shows a partial disassembly of the file, along with offset, contents, and ASCII values of each location. In addition it shows all REFs and DEFs, and the program entry point.

The syntax for EAU2ASC.EXE is:

```
> eau2asc <infile> <outfile>
```

<outfile> can be read by an ASCII editor.

8.8.8. IV2ASC.EXE.

Takes an extracted TI Extended Basic INT/VAR254 program file and converts to ASCII. The output is similar to LISTing a TI Extended Basic program in INT/VAR254 format. The converted file can be loaded into PC Basic. [Not all TI Extended Basic statements are valid in PC Basic.]

The syntax for IV2ASC.EXE is:

```
> iv2asc <infile> <outfile> {/a}
```

The optional /a switch will dump all information. This includes the line number table and the bytes that make up each Basic line.

8.8.9. MRG2ASC.EXE.

Takes an extracted TI Basic or Extended Basic INT/VAR163 file saved in MERGE format and converts to ASCII. The converted file can be loaded into PC Basic. [Not all TI Basic statements are valid in PC Basic.]

The syntax for MRG2ASC.EXE is:

```
> mrg2asc <infile> <outfile>
```

8.9. Extracting TI Forth screens (DSKOUTF.EXE)

You can extract one or more screens from an emulated TI Forth disk and store them as a standalone DOS file. You use the DSKOUTF.EXE program to do this. DSKOUTF.EXE needs to know the name of the TI emulated disk file, the name of the DOS file to create, and the starting and ending screen number.

The syntax is:

```
dskoutf <ti forth disk> <outfile>
            <screen lo (decimal)> <screen hi (decimal)> [options]
```

[options] can be:

1. Print screen line numbers (00 - 15)
2. Print screen numbers at top of screen
3. Print screen line numbers and screen numbers.

Example: To extract from DSK1 the TI Forth screens 3 through 5 and create the DOS file \TMP\FORTH.OUT.

```
> c:
> cd \pc99\dskutil
> dskoutf \pc99\dsk\dsk1 \tmp\forth.out 3 5
```

Example: To extract from FORTH.DSK the TI Forth screens 20 through 22 and create the DOS file \TMP\FORTH.OUT and print screen line numbers and screen numbers.

```
> c:
> cd \pc99\dskutil
> dskoutf \pc99\dsk\forth \tmp\forth.out 20 22 3
```

8.10. Extracting p-System files (DSKOUTP.EXE)

You can extract a file from an emulated p-System disk and store it as a DOS file. You use the DSKOUTP.EXE program to do this. DSKOUTP.EXE needs to know the name of the TI emulated disk file, the TI p-System filename to extract, and the name of the DOS file to create.

The syntax is:

```
dskoutp <TI p-System disk file> <p-System filename> <DOS filename>
```

Example: To extract from DSK2 the p-System file MODRS232.TEXT and create the DOS file MODRS232.TXT.

```
> c:
> cd \pc99\dskutil
> dskoutp \pc99\dsk\dsk2 MODRS232.TEXT \tmp\modrs232.txt
```

The file extracted by DSKOUTP is in TI p-System format, and usually has non-ASCII codes in it. You can convert the file to ASCII with the following conversion utility:

8.10.1. PAS2ASC.EXE

Takes a file extracted by DSKOUTP.EXE and converts to ASCII. The syntax for PAS2ASC is:

```
> pas2asc <input file> <output file> [mode]
```

<input file> is the name of the file created by DSKOUTP.EXE. <output file> is the ASCII output of PAS2ASC.EXE.

[mode] can be 0-3:

mode 0: characters less than 0x20 and greater than 0x7f are not output. Non-ASCII characters are therefore not output. All characters output will be in the ASCII range 0x20 through 0x7f. If no mode is specified, then mode 0 is used.

mode 1: all characters are output. Non-ASCII characters are output as <nn>.

mode 2: characters less than 0x20 are not output. Non-ASCII characters are output as <nn>.

mode 3: characters greater than 0x7f are not output. Non-ASCII characters are output as <nn>.

This utility allows you to exchange files between the TI p-System and PC p-Systems.

8.11. Importing DOS files to a TI file system (DSKIN.EXE)

DSKIN.EXE will take a DOS file and store it in a TI "disk". The DOS file must have been prepared by a program that builds a TI File Descriptor Record (FDR) as the first 256 bytes of the file.

DSKIN.EXE should only be used with a blank TI "disk", such as a copy of FMT21.DSK or FMT22.DSK. DSKIN.EXE stores the input file in contiguous sectors starting at sector >022. DSKIN.EXE does not know how to create fractured files. This means you cannot use successive iterations of DSKIN.EXE to import multiple files.

After you have imported a file with DSKIN.EXE, the file must be copied to another disk using a disk manager, such as Disk Manager 2 or DM-1000. DSKIN.EXE attempts to fill the sector bitmap correctly, but this may not be reliable.

You can then copy FMT21.DSK or FMT22.DSK over the import disk, and import the next file.

WARNING: If you use DSKIN.EXE on a non-blank disk you will destroy the disk.

The syntax for DSKIN.EXE is:

```
> dskin <dos filename> <ti dsk filename>
```

The name of the TI file on the TI disk is contained in the FDR header of <dos filename> and was built by another program (such as ASC2DV80.EXE or DLCONV.EXE).

The following conversion utilities are supplied with PC99 for use with DSKIN.EXE:

8.11.1. ASC2DV80.EXE

Takes a DOS ASCII file and converts it for use with DSKIN.EXE. The syntax for ASC2DV80.EXE is:

```
> asc2dv80 <infile> <outfile> <TI filename>
```

<infile> is the DOS file you wish to store in the TI disk.

<outfile> is the output file created by ASC2DV80.EXE.

<TI filename> is the TI filename you want the converted file to have when it is cataloged on the TI disk. This filename must follow TI conventions, and cannot be longer than 10 characters.

Example: You have a WordPerfect file called FRED.WPD that you wish to bring up in TI-Writer.

1. Load FRED.WPD into WordPerfect and then save the file as DOS Text. Call the saved file \TMP\FRED.TXT

2. Run ASC2DV80.EXE.

```
> c:
> cd \tmp
> \pc99\dskutil\asc2dv80 fred.txt fred.ti FRED
```

3. Save the current disk in DSK2.

```
> cd \pc99\dsk
> copy dsk2 mydisk.dsk
```

4. Ensure there is a blank disk in DSK2.

```
> copy fmt21.dsk dsk2
```

5. Run DSKIN.EXE

```
> \pc99\dskutil\dskin \tmp\fred.ti dsk2
```

6. If you now load TI-Writer you will be able to catalog DSK2 and see the single file FRED. In addition, you can use TI-Writer to open the file and edit it and the TI Disk Manager to copy the file to another disk.

8.11.2. BIN2PGM.EXE

Takes a DOS binary file containing a TI Basic or Extended Basic file in PROGRAM format and converts it for use with DSKIN.EXE. The syntax for BIN2PGM.EXE is:

```
> bin2pgm <infile> <outfile> <TI filename> [strip]
```

<infile> is the DOS binary file containing the PROGRAM file you wish to store in the TI disk.

<outfile> is the output file created by BIN2PGM.EXE.

<TI filename> is the TI filename you want the converted file to have when it is cataloged on the TI disk. This filename must follow TI conventions, and cannot be longer than 10 characters.

<strip> is the number of header bytes on the downloaded file to skip. Defaults to 128.

Example: You have downloaded a file from a bulletin board called DOWNLOAD that has a 128-byte header, and contains a program called TUNNEL_X. The file is in \TMP.

1. Save the current disk in DSK1.

```
> c:
> cd \pc99\dsk
> copy dsk1 mydisk.dsk
```

2. Ensure there is a blank disk in DSK1.

```
> copy fmt21.dsk dsk1
```

3. Convert the downloaded file. There is no need to give a strip value, since it defaults to 128.

```
> \pc99\dskutil\bin2pgm \tmp\download \tmp\download.ti tunnel_x
```

4. Run DSKIN.EXE

```
> \pc99\dskutil\dskin \tmp\download.ti dsk1
```

5. If you now start TI Basic (or Extended Basic) you can load the file from DSK1.

8.11.3. DLCONV.EXE

Takes a DOS binary file containing a "TI FILES" header and converts it for use with DSKIN.EXE. The syntax for DLCONV.EXE is:

```
> dlconv <infile> <outfile> <TI filename>
```

<infile> is the DOS binary file, usually downloaded from a bulletin board.

<outfile> is the output file created by DLCONV.EXE.

<TI filename> is the TI filename you want the converted file to have when it is cataloged on the TI disk. This filename must follow TI conventions, and cannot be longer than 10 characters.

Example: You have downloaded a file from a bulletin board called SONGS.ARK that has a 128-byte TI FILES header, which contains an archived file called SONGS. The file is in \TMP. You will also need Barry Boone's Archiver program, which is included on PC99.DSK.

1. Save all current disks, if necessary.

```
> c:
> cd \pc99\dsk
> copy dsk1 mydisk1.dsk
> copy dsk2 mydisk2.dsk
> copy dsk3 mydisk3.dsk
```

2. Copy the PC99 disk containing Archiver to DSK1.

```
> copy pc99.dsk dsk1
```

3. Ensure there is a blank disk in DSK2 and DSK3.

```
> copy fmt21.dsk dsk2
> copy fmt21.dsk dsk3
```

4. Convert the downloaded file.

```
> \pc99\dskutil\dlconv \tmp\songs.ark \tmp\songs.ti songs
```

5. Run DSKIN.EXE

```
> \pc99\dskutil\dskin \tmp\songs.ti dsk2
```

6. Start PC99 with the Editor/Assembler. From E/A5 load DSK1.ARC33_1. Set the input drive to 2, and the output drive to 3. All files will be extracted from the downloaded archive to DSK3.

7. Exit PC99 and save DSK3.

```
> cd \pc99\dsk
> copy dsk3 {dosname}.dsk
```

where {dosname} is any name you want up to 8 characters (e.g. DNLOAD8.DSK).

8.11.4. VF2PC99.EXE

Takes a single v9t9 "file in a directory" and converts it to PC99 format. The syntax is:

```
> vf2pc99 <file in a directory> <PC99 dskin file> {cnt}
```

A v9t9 file in a directory contains a 128-byte header. VF2PC99.EXE uses the first 17 bytes of the header to construct a standard 256-byte TI FDR. In some cases, there is non-standard information in the header, or more than 17 bytes are required. You can adjust the number of bytes used from the header with {cnt}. This value can be from 17 to 128.

Example: You want 19 bytes of the v9t9 header to appear in the FDR.

```
> \pc99\dskutil\vf2pc99 \tmp\vfile \tmp\pc99.in 19
```

8.11.5. VD2PC99.EXE

Takes a v9t9 "disk on a disk" and converts it to PC99 format. The syntax is:

```
> vd2pc99 <disk on a disk> <PC99 dsk file> {1 = verbose}
```

A v9t9 disk on a disk is a 92,160-byte file, representing 360 sectors on a TI SSSD disk. Each sector contains 256 bytes. VD2PC99.EXE uses this data to reconstruct a PC99 dsk file. A PC99 dsk file contains the sector data in interlaced sector format, as well as inter-sector information, used by low-level functions in the disk controller chip.

<disk on a disk> must be 92,160 bytes.

<PC99 dsk file> must be 260,240 bytes. You can use FMT21.DSK to create a blank file.

{1 = verbose} will print out the sector number being processed.

The output of this file is a PC99 dsk file which can be used without further processing.

8.12. Dumping a TI ROM (DUMPROM.EXE)

Use DUMPROM.EXE, a program that lives in \PC99\UTIL, to dump a TI ROM to a readable ASCII file:

```
> c:
> cd \pc99\util
> dumprom \pc99\modules\con4ar0.rom \tmp\junk
```

DUMPROM.EXE will read the ROM header and find the base address and length. The output is in the form:

```
base address            hex contents
base address + 2        hex contents
...
```

Use an ASCII editor to look at the output file.

8.13. Patching a TI ROM or GROM (PATCH.EXE)

Use PATCH.EXE, a program that lives in \PC99\UTIL, to make one-byte patches to files.

Example: Shows how the original RS232 ROM file was patched.

```
Location    Old         New
>4344       0007        0001
```

First remove the base address value of the ROM to calculate the offset into the file:

```
>4344 - >4000 = >0344
```

Add to this offset the six extra bytes in a ROM file containing the TI file header:

```
>0344 + >0006 = >034a
```

Finally, since the patch is to the low order byte, and the high order byte does not change, add one more for the correct offset:

```
>034a + >0001 = >034b
```

Make a copy of the original file and then use PATCH.EXE to make the actual patch. The syntax for PATCH.EXE is:

```
patch <input file> <output file> <offset> <old value> <new value>
```

All values are in hex.

```
> c:
> cd \pc99\modules
> copy p1300r0.rom p1300r0.org
> \pc99\util\patch p1300r0.org p1300r0.rom 34b 7 1
```

If PATCH.EXE does not find the expected value it will report the error.

If you have to make a lengthy patch, create a batch file, and use temporary intermediate files.

Note: The above patch has been made to the file supplied with PC99.

8.14. Converting Command Modules.

To convert a TI Command Module you must have:

- A GRAM device, such as the Gramulator.
- A method of transferring files from the TI to the PC.

8.14.1. GRAM devices.

The first commercial GRAM device was the Gram Kracker, from Millers Graphics. This is no longer in production. The Gramulator, from CaDD Electronics, offers even more capability than the Gram Kracker, but is also no longer in production.

You need to follow the instructions of your GRAM device manufacturer to dump a command module to disk. These files have a format developed by Millers Graphics, and extended by CaDD. The format consists of a 6-byte header (8 bytes for MBX):

Byte 0:	0xff = more files to load, 0x00 = last file.
Byte 1:	Memory type (GROM number, RAM bank, MBX RAM...)
Bytes 2-3:	Data length.
Bytes 4-5:	TI load address.
Bytes 5-6:	Bank address (MBX only)

Typically, each file consists of a base name, followed by an incrementing digit.

PC99 understands this format and will load these files into the corresponding emulated TI memory. When PC99 finds the last file in the chain it will stop the load. If you set Show Startup Info to YES with CFG.EXE, PC99 shows where in memory each file was loaded, its load address, and its data length.

8.14.2. Transferring GRAM files.

- Create the GRAM files on the 99/4A following the instructions of your GRAM device manufacturer.
- Use Read Sector and Write sector to transfer the disk containing the GRAM files to PC99 (described above). Extract the GRAM files from the PC99 disk to DOS using DSKOUT.EXE (described above).

  OR

  Run a terminal emulator on both the 4A and the PC and transfer the files.

  OR

Use PC Transfer to transfer the GRAM files to DOS.

- Use GSTRIP.EXE to strip off unwanted header bytes.
- Use GREAD.EXE to strip off unwanted trailer bytes.
- Use PATCH.EXE to patch any incorrect values in the files.

8.14.3. Conversion example.

This example assumes you are converting the command module Alpiner (PHM 3056) using PC Transfer.

- Create the Alpiner GRAM files using your GRAM device. In this example the base file was named PHM3056. The GRAM device created five files. The table shows the filenames, the first six bytes of the file, the memory type to load into, the data length, and the memory starting address:

```
Filename    First six bytes    Type    Length  Load address
PHM3056     FF 09 20 00 60 00  RAM 0   >2000   >6000
PHM30561    FF 07 18 00 C0 00  GRAM 7  >1800   >C000
PHM30562    FF 06 18 00 A0 00  GRAM 6  >1800   >A000
PHM30563    FF 05 18 00 80 00  GRAM 5  >1800   >8000
PHM30564    00 04 18 00 60 00  GRAM 4  >1800   >6000
```

  The first byte in each of the first four files is >FF which means another file is to be loaded. The first byte in the last file is >00, which means no more files are to be loaded.

- Transfer the five files to the PC.
- Use STRIP.BAT to remove the unwanted 128 header bytes. This example assumes the module files are in C:\TMP. Edit the STRIP.BAT file to contain five lines:

```
\pc99\util\gstrip.exe \tmp\phm3056 \tmp\m3056 128
\pc99\util\gstrip.exe \tmp\phm30561 \tmp\m30561 128
\pc99\util\gstrip.exe \tmp\phm30562 \tmp\m30562 128
\pc99\util\gstrip.exe \tmp\phm30563 \tmp\m30563 128
\pc99\util\gstrip.exe \tmp\phm30564 \tmp\m30564 128
```

  Run STRIP.BAT to create the intermediate files m3056, m30561, ...

- Fix up the file size for each file:

  The 8K ROM file PHM3056 consists of a 6-byte header followed by 8192 bytes of data. When PC Transfer copies this file from a TI disk to a DOS disk it does so in multiples of 256 bytes. Although 8192 is an exact multiple of 256, the addition of the 6-byte header makes the file size 8198 bytes. Since this is no longer a multiple of 256, PC Transfer pads the end of the file with 250 bytes. This results in a DOS file size of 8448 bytes (8198 + 250 bytes).

  If you use CFG.EXE to check this file, it will report a file size error. The same problem occurs with the transferred 6K GROM files (PHM30561, PHM30562...). [If you were transferring an MBX file, the same problem would occur with a 4K MBX file.]

  In addition, CFG.EXE will also check the 6-byte file header and ensure that the data length bytes at offset 2 and 3 have the correct value. For example, CFG.EXE will not allow the value of 0x2000 (8192 bytes) as a data length in a 6K GROM file (6150 bytes), since this instructs the loader to load 8192 bytes from a 6150-byte file.

  Note: MBX files actually have an 8-byte header. The extra two bytes contain information about which MBX RAM bank to load.

  The following table shows the file type, the size of the file created by PC Transfer, the correct DOS file sizes for each type of file, and the value of the two data length bytes in the 6-byte file header:

```
File type         PC Transfer DOS size    Data length

8K ROM/GRAM       8448 bytes  8198 bytes  0x20 0x00
6K GROM           6400 bytes  6150 bytes  0x18 0x00
4K MBX            4352 bytes  4102 bytes  0x10 0x02
```

  Use STRIP.BAT to fix the file sizes. This example assumes the input files are in C:\TMP. Edit the STRIP.BAT file to contain the following five lines:

```
\pc99\util\gread \tmp\m3056 \tmp\g3056 8198
\pc99\util\gread \tmp\m30561 \tmp\g30561 6150
\pc99\util\gread \tmp\m30562 \tmp\g30562 6150
\pc99\util\gread \tmp\m30563 \tmp\g30563 6150
\pc99\util\gread \tmp\m30564 \tmp\g30564 6150
```

  Run STRIP.BAT to create the intermediate files g3056, g30561, ...

- Once you have fixed the size of each file, use DUMP.EXE to examine the 2 data length bytes starting at offset 2. The data length values are shown in the table above. If the values are different, you can use PATCH.EXE to fix them.

  This example assumes the GRAM file g30561 has a correct file size of 6150 bytes, but the value of the 2 data length bytes starting at offset 2 is 0x20 and 0x00:

  Use STRIP.BAT to fix the offset values. This example assumes the input files are in C:\TMP. Edit the STRIP.BAT file to contain the following line:

  ```
  \pc99\util\patch \tmp\g30561 \tmp\p30561 2 20 18
  ```

  This patches g30561 so that offset 2, which used to contain 0x20, now contains 0x18. There is no need to patch the byte at offset 3, since it is 0x00.

  Run STRIP.BAT to create the intermediate file p30561. The data length starting at offset 2 is now 0x1800.

- Now copy the stripped and patched files to the PC99 modules directory:

  ```
  > cd \tmp
  > copy g3056 \pc99\modules\phm3056.grm
  > copy p30561 \pc99\modules\phm30561.grm
  > copy g30562 \pc99\modules\phm30562.grm
  > copy g30563 \pc99\modules\phm30563.grm
  > copy g30564 \pc99\modules\phm30564.grm
  ```

- Finally, you should add the name and the pathnames of the command module files to PC99.MOD. The following example shows the Alpiner module added at the end of your module list:

  ```
  ...
  ...
  [alpiner]
  \pc99\modules\phm3056.grm
  \pc99\modules\phm30561.grm
  \pc99\modules\phm30562.grm
  \pc99\modules\phm30563.grm
  \pc99\modules\phm30564.grm
  $
  ```

  This selection will become available the next time you run CFG.EXE.

  Note: The last entry in PC99.MOD must be a $ on a line by itself.

  The file PC99.MMM in \PC99 contains a master list of modules. If you create a new module, you can use an ASCII editor to cut its entry from PC99.MMM and paste it into PC99.MOD.

Note: This example shows each stage of conversion separately. You can of course combine the stages into a single batch file.

8.15. Speech utilities

Two utilities let you examine the contents of the Speech Synthesizer ROM.

8.15.1. Displaying the Speech Synthesizer index (SPDUMP.EXE)

The Speech Synthesizer ROM contains an index for each word or phrase. This index is described in Section 22.2.2 of the Editor/Assembler manual. SPDUMP.EXE can read the index and display it to stdout. You can re-direct this output to a disk file.

The syntax for SPDUMP.EXE is:

```
> spdump <infile>
```

<infile> is a file containing the TI Speech Synthesizer ROM.

Example:

```
> c:
> cd \pc99\util
> spdump \pc99\modules\p5200r0.rom > \tmp\junk
```

The file \tmp\junk will contain the index showing the length (Ln [decimal]), Speech ASCII, less-than pointer (<ptr [hex]), greater-than pointer (>ptr [hex]), speech data pointer (spdata [hex]), and speech data length (len [decimal]).

8.15.2. Displaying Speech Synthesizer codes (SPCODE.EXE)

The Speech Synthesizer ROM contains speech data in bit-packed format. This format is described in the TMS5200 data manual. SPCODE.EXE can unpack the speech data and display it to stdout. You can re-direct this output to a disk file.

The syntax for SPCODE.EXE is:

```
> spcode <infile> <hex offset>
```

<infile> is a file containing the TI Speech Synthesizer ROM.

<hex offset> is the value of the "speech data pointer" field for a word or phrase found using SPDUMP.EXE. This value can also be found in the Editor/Assembler manual in Section 24.6.

Example: To unpack the word "HELLO" at offset >351A.

```
> c:
> cd \pc99\util
> spcode \pc99\modules\p5200r0.rom 351a > \tmp\junk
```

The file \tmp\junk will show the energy (En), repeat value (R), pitch (Pt), and coefficients K1 through K10 for each frame in the word.

8.16. Displaying TI-Artist files (ART.EXE)

You can use DSKOUT.EXE to extract TI-Artist files from a TI disk to DOS. You can then use ART.EXE to display the extracted file.

The syntax is:

```
> art /a <TI-Artist filename (no _P or _C)>
```

Example: Display the logo on the TI-Artist disk in DOS. Assume the TI-Artist disk is copied to DSK1.

```
> c:
> cd \pc99\dskutil
> dskout \pc99\dsk\dsk1 logo_c \tmp\logo_c
> dskout \pc99\dsk\dsk1 logo_p \tmp\logo_p
> cd \pc99\util
> art /a \tmp\logo
```

ART.EXE has the following switches:

/a Requires both the _C (color) and _P (pixel) file. The /a switch only requires the "base" name (no _P or _C).

Example:

```
> art /a \tmp\logo
```

/b Set background color to value following /b. Must be used with /c. /c tells ART.EXE to ignore the _C (color) file and only use the _P (pixel) file.

Example:

```
> art /b 14 /c \tmp\logo
```

skips the use of the _C (color) file, and sets all background pixels to gray (14).

/c Tells ART.EXE to ignore the _C (color) file. Must be used with /f (foreground), or /b (background).

/f Set foreground color to value following /f. Must be used with /c. /c tells ART.EXE to ignore the _C (color) file and only use the _P (pixel) file.

Example:

```
> art /f 6 /c \tmp\logo
```

skips the use of the _C (color) file, and sets all foreground pixels to dark red (6).

/p Displays the file, and then prints it to disk as a PCX file. This is a common PC file format used by many PC applications.

Example:

```
> art /a logo /p \tmp\logo.pcx
```

Creates the PCX file \tmp\logo.pcx from the TI-Artist files \tmp\logo_c and \tmp\logo_p.

/r Used with a value to delay the time the TI-Artist file is displayed on the screen. This is useful when running ART.EXE from a batch file, and allows you to generate a "slide show".

Example:

```
> art /a \tmp\logo /r 2000
```

The value 2000 is counted through an internal loop that depends on the speed of your PC.

/s Sets the TI screen color in the overscan area. For most applications this would be cyan (7). You can change this value to make a particular file "fill" the TI screen, or create a top and bottom border in the color you select.

Example:

```
> art /a \tmp\logo /s 10
```

sets the top and bottom screen borders to dark yellow (10).

/v Sets the video type. The video types are:

1 The PC video mode is set to 320 x 200 x 256 colors.
2 The PC video mode is set to 640 x 480 x 256 colors. TI pixels are drawn 1 for 1, making the image appear small and in the top-left corner.
3 The PC video mode is set to 640 x 480 x 256 colors. TI pixels are drawn 4 for 1 to fill a 512 x 400 space, making the image appear full-size and correctly proportioned to match the TI screen.

8.16.1. Using ART.EXE to create a slide show

You can repeatedly call ART.EXE from a batch file to create a slide show. The following example batch file assumes you have the files ART.EXE, CASTLE_P, CASTLE_C, FUJI_P, FUJI_C, LOGO_P.... in the same directory that the batch file is being run from:

```
@echo off
art /a castle /r 2700 /s 7 /v 3
art /a fuji /r 2700 /s 1 /v 3
art /a logo /r 2700 /s 1 /v 3
art /a dmtitl /r 2700 /s 7 /v 3
art /a skull /r 2700 /s 1 /v 3
art /a beatle /r 2700 /s 1 /v 3
art /a hubert /r 2700 /s 1 /v 3
art /a sea /r 2700 /s 1 /v 3
mode co80
```

/a is the basename, /r is the delay, /s is the overscan color, and /v is the video type.

8.17. Using PC99 utilities in batch files

DOS defines a batch file as: "An unformatted text file that contains one or more DOS commands and is assigned a .BAT extension. When you type the name of the batch program at the command prompt, the commands are carried out as a group."

All of the PC99 utility programs are designed to be called from a batch file. This can let you create your own "utilities".

8.17.1. Bulletin board files

Example: You frequently download files from bulletin boards and want to use them in PC99. The following is an example batch file to do this. It is called DL.BAT.

The calling syntax is:

DL <path to downloaded file> <TI dsk filename>

The batch file is:

```
@echo off
echo BBS download to PC99

rem check for two arguments on command line

if .%1 == . goto usage
if .%2 == . goto usage

rem save the current disks in dsk1, dsk2, dsk3

echo Saving dsk1, dsk2, dsk3...
copy c:\pc99\dsk\dsk1 c:\pc99\dsk\dsk1.sav
copy c:\pc99\dsk\dsk2 c:\pc99\dsk\dsk2.sav
copy c:\pc99\dsk\dsk3 c:\pc99\dsk\dsk3.sav

rem set up the disks to use archiver

echo Setting up dsk1, dsk2, dsk3...
copy c:\pc99\dsk\pc99.dsk c:\pc99\dsk\dsk1
copy c:\pc99\dsk\fmt21.dsk c:\pc99\dsk\dsk2
copy c:\pc99\dsk\fmt21.dsk c:\pc99\dsk\dsk3

rem use dlconv to convert the file

echo Running dlconv...
c:\pc99\dskutil\dlconv %1 c:\tmp\junk %2

rem use dskin to import the file
```

```
echo Running dskin...
c:\pc99\dskutil\dskin c:\tmp\junk c:\pc99\dsk\dsk2

echo Done.
echo Downloaded file is stored in DSK2.

goto exit

:usage
echo usage dl {path of downloaded file} {TI filename}
echo Ex: dl c:\tmp\songs.ask SONGS
goto exit

:exit
```

You can now run PC99 and use Barry Boone's Archiver to extract the files in the archive DSK2.SONGS.

8.17.2. Formatting Basic files

Use the following batch file if you have a TI Basic or Extended Basic PROGRAM file on a PC99 disk, and wish to extract it, convert it to ASCII, and then format it to 28 columns to match the TI screen display.

```
echo "disk "%1 :: "file "%2

\pc99\dskutil4\dskout %1 %2 \tmp\junk
\pc99\dskutil\bas2asc \tmp\junk \tmp\junk.bas
\pc99\dskutil\basfmt \tmp\junk.bas \tmp\junk.out
```

Store this file in \pc99\dsk and call it basfmt.bat. Ensure you have a \tmp directory. If not, you can substitute a directory of your choice. The syntax is:

```
basfmt <disk filename> <Basic program name>
```

Example: The pc99.dsk file delivered with PC99 contains the program XLATE_X, an Extended Basic program.

```
c:
cd \pc99\dsk
basfmt pc99.dsk xlate_x
```

The batch file:

1. Calls dskout.exe to extract the file and store it in \tmp\junk.
2. Calls bas2asc to convert junk (a binary file) to junk.bas (an ASCII file).
3. Calls basfmt to convert the junk.bas to a formatted 28-column ASCII file.

You can use an ASCII editor to examine junk.bas, or import it into a word processor, such as WordPerfect.

9. PC99.DSK utility programs

The following is a catalog of the programs on PC99.DSK:

```
dskdir. v2.0. 12-dec-96
Disk name               = PC99
Sectors total           = 720
Sectors used            = 386
Sectors available       = 332
Sectors/track           = 9
Disk formatted (DSK)    = yes
Disk Manager protection = no
Tracks per side         = 40
Number of sides         = 2
Density                 = single

No. FDR  Filename   Size Type       P
--- ---- ---------- ---- ---------- -
001 >002 ARC33_1      33 PROGRAM      >020 032
002 >003 ASSM1        33 PROGRAM      >040 032
003 >004 ASSM2        20 PROGRAM      >060 019
004 >005 BSCSUP       15 DIS/FIX 80   >073 014
005 >006 DEBUG        32 DIS/FIX 80   >081 031
006 >007 DM            4 DIS/FIX 80   >0a0 003
007 >008 DM1          57 PROGRAM      >0a3 056
008 >009 DM2          22 PROGRAM      >0db 021
009 >00a EDIT1        25 PROGRAM      >0f0 024
010 >00b FILETOPROG   27 DIS/FIX 80   >108 026
011 >00c RSECTOR      14 PROGRAM      >122 013
012 >00d RSECT_O      23 DIS/FIX 80   >12f 022
013 >00e SECTLOAD_X   22 PROGRAM      >145 021
014 >00f WSECTOR      14 PROGRAM      >15a 013
015 >010 WSECT_O      25 DIS/FIX 80   >167 024
016 >011 XLATE_X      20 PROGRAM      >17f 019
```

In the following descriptions, all Texas Instruments software is supplied under license with TI.

9.1. ARC33_1

This is Archiver 3.03, dated 4/12/89. This is a shareware program by Barry Boone.

9.2. ASSM1, ASSM2

These two files are the TI assembler, as supplied with the Texas Instruments Editor/Assembler package (PHM 3055).

9.3. BSCSUP

This file is the Basic support package, as supplied with the TI Editor/Assembler.

9.4. DEBUG

This file is the 99/4 Debugger, as supplied with the TI Editor/Assembler.

9.5. DM, DM1, DM2

These three files are the Myarc Disk Manager Level III Supreme, as supplied with the Myarc Disk Controller. These files are supplied with permission from Myarc, Inc.

Example: To load the Myarc Disk Manager Level III Supreme. Warning: this will destroy DSK1.

```
> c:
> cd \pc99\dsk
> copy pc99.dsk dsk1
> cd ..
> cfg /m editor
> pc99

Press a key

Select 2. FOR EDITOR/ASSEMBLER

Select 3. TO LOAD AND RUN
```

At the FILE NAME prompt, enter: DSK1.DM

The Myarc Disk Manager Level III will load and display its title screen.

Note: For documentation on how to use the Myarc Disk Manager Level III Supreme, see \pc99\doc\mydmdoc.pdf (Acrobat format) or \pc99\doc\mydmdoc.txt (ASCII format).

9.6. EDIT1

This file is the Editor, as supplied with the TI Editor/Assembler.

9.7. FILETOPROG

This file is the Super Save utility. This is a fairware program by Erik Olson.

9.8. RSECTOR, RSECT_O, SECTLOAD_X, WSECTOR, WSECT_O

These files are the PC99 Read/Write Sector programs, described in an earlier section.

9.9. MMLOAD_M, MMSAVE_M

If you have the Mini-Memory module, these utilities allow you to load and save the contents of the Mini Memory RAM to disk. The file MINIMEM_D is a copy of the Line-By-Line Assembler tape that Texas Instruments supplied with the Mini Memory. This tape includes the Line-By-Line Assembler and the LINES demo program.

To load the "tape" into the Mini Memory:

```
> c:
> cd \pc99\dsk
> copy pc99.dsk dsk1          (WARNING: Will destroy current DSK1)
> cd \pc99
> cfg -m mini memory
> pc99a
```

Select 1. TI BASIC. At the BASIC prompt:

```
> OLD DSK1.MMLOAD_M
> RUN
```

The program will prompt you for a file to load:

```
DSK1.MINIMEM_D
```

The "tape" is now loaded into the Mini-Memory RAM. To start the Line-By-Line Assembler:

Press **FCTN =** to quit to the TI Title Screen.
Press any key.
Select 3. MINI MEMORY.
Select 2. RUN

```
PROGRAM NAME ? NEW
```

The Assembler is loaded.

To run the LINES demo program, enter LINES instead of NEW.

9.9.1. Loading large TI Basic programs

TI Basic programs cannot use Memory Expansion. Extended Basic programs can use Memory Expansion.

TI Basic programs are stored in VDP memory, which contains buffer areas used by the Disk Controller. Because of this, a large TI Basic program that runs on a cassette system may not have sufficient VDP memory to run on a disk system.

If you load such a program from disk, and RUN, you will get:

```
MEMORY FULL IN nnnn
```

where nnnn is the line number.

There are a number of ways to overcome this. This section covers three. You should try them in order:

1. **Run the TI Basic program under TI Extended Basic**

   This will work if the TI Basic program does not use character sets 15 and 16. These are not available under Extended Basic. If the TI Basic program uses these sets, you will get:

   ```
   BAD VALUE IN nnnn
   ```

   where nnnn is the line number.

2. **Reduce the number of disk buffers**

   a. Select TI Basic
   b. > CALL FILES(1)
   c. OLD DSK1.<program name>
   d. RUN

3. **Save and load the program from Mini Memory**

This technique loads the program from disk, and then saves it to Mini Memory EXPMEM2. The disk controller is then "turned off" with a CALL LOAD, and the program is loaded from EXPMEM2.

a. Load the Mini Memory module
b. Select TI Basic
c. CALL FILES(1)
d. OLD DSK1.<program name>
e. SAVE EXPMEM2
f. CALL LOAD(-31888,63,255) [no VDP RAM for disk buffers]
g. NEW
h. OLD EXPMEM2
i. RUN

9.10. XLATE_X

This file is a version of the program that was first published in Micropendium, 2:11:49. This program converts a Basic text file into merge format.

10. PC99 patches

A PC99 patch is defined as a change to an original TI file. The following patches are incorporated in this release.

In the rare and unlikely case that some TI application depends on the instruction order in the original ROMs or GROMs, you can use the PC99 PATCH.EXE utility to restore the original ROM or GROM. Note that offsets to addresses in the ROM or GROM file require +6 to allow for the 6-byte file header. For example, address >0918 would be at offset 0x0918 + 0x0006 = 0x091E.

10.1. Console ROM 0: Speeding up the keyboard

The 99/4A ROM 0 contains a delay loop in the keyboard routine to allow CRU lines to settle. This is not necessary in PC99. Reducing the size of the loop counter speeds up the keyboard response in PC99 for all programs that call KSCAN.

Original 99/4A ROM 0:

```
>0498 020C  LI    R12,>04E2   Loop counter
>049A 04E2
```

Patched 99/4A ROM 0:

```
>0498 020C  LI    R12,>0002   Loop counter
>049A 0002
```

This shortens the delay loop considerably.

The patch is made to the file CON4AR0.ROM, which lives in \PC99\MODULES.

10.2. Console ROM 0: Bug in interrupt routine

The following excerpt is from an email by TI'er Jeff White: "...looking over the console ROM source code (I) have located the main problem with the interrupt routine. Two instructions are reversed. What should be there is the reverse, which could solve lots of trouble ..."

Original 99/4A ROM 0:

```
>0918 020C  LI    R12,>0F00   Loads CRU base with >0F00
>091A 0F00                     to start CRU scan of DSR peripherals
>091C 1D01  SBO   1           Enables meaningless bit >0F02!
```

Patched PC99 ROM 0:

```
>0918 1D01  SBO   1           Clears External Interrupt and re-enables
>091A 020C  LI    R12,>0F00   Loads CRU base with >0F00
>091C 0F00                     to start CRU scan of DSR peripherals
```

The patch is made to the file CON4AR0.ROM, which lives in \PC99\MODULES.

10.3. Console GROM 0: Bug in REVIEW MODULE LIBRARY

If multiple GROM banks are available on a GRAM device connected to a 4A, the GROM scan routine will cycle indefinitely and never display the TI selection screen. This is due to a bug in the TI GPL code.

Original 99/4A GROM 0:

```
0241  41    BR    ROM@>01B9   Restart scan!
0242  B9
```

Patched 99/4A GROM 0:

```
0241  0A    GT                Fake no-op
0242  0A    GT                Fake no-op, and allow scan to complete
```

This prevents the routine from looping forever by replacing the branch with two fake no-ops.

The patch is made to the file CON4AG0.GRM, which lives in \PC99\MODULES.

10.4. RS232 card ROM: Reducing timeout

The software in the RS232 card ROM uses the value at >4344 as a delay counter. This value is loaded into the TMS9902 and prevents transmission of data taking place until it has counted down to zero.

Original RS232 ROM:

```
>4342 0205  LI    R5,>0007    Timeout in 7*>C01C loops
>4344 0007
```

Patched RS232 ROM:

```
>4342 0205  LI    R5,>0001    Timeout in 1*>C01C loops
>4344 0001
```

This reduces the timeout from up to two minutes to 30 seconds.

The patch is to the file P1300R0.ROM, which lives in \PC99\MODULES.

11. In case of difficulty.

11.1. Can't execute PC99.EXE

PC99 attempts to put your PC into protected mode by invoking DOS4GW.EXE, the Rational Systems linear executable loader. DOS4GW.EXE must be in the directory in which you start PC99, or else it must be in your path.

You can measure the performance of protected/real-mode switching on your PC by running the Rational Systems program PMINFO.EXE. This is installed in \PC99\UTIL.

If PMINFO.EXE fails to complete you can run the Rational Systems program RMINFO.EXE. This is installed in \PC99\UTIL. This program supplies configuration information and the basis for real/protected-mode switching on your PC.

Between these two programs you should be able to discover the reason your PC cannot be switched into protected mode.

11.1.1. PMINFO.EXE

The following information is supplied by Rational Systems, which wrote PMINFO.EXE:

PMINFO.EXE

Purpose: Measures the performance of protected/real-mode switching and extended memory.

Syntax: PMINFO.EXE

Notes: We encourage you to distribute this program to your users.

The time-based measurements made by PMINFO may vary slightly from run to run.

Example: The following example shows the output of the PMINFO program on a 386 AT-compatible machine.

```
C>pminfo
  Protected Mode and Extended Memory Performance Measurement -- 5.00
  Copyright (c) Tenberry Software, Inc. 1987 - 1993

  DOS memory   Extended memory   CPU performance equivalent to 67.0 MHz 80486
  ----------   ---------------
         736              8012   K bytes configured (according to BIOS).
         640             15360   K bytes physically present (SETUP).
         651              7887   K bytes available for DOS/16M programs.
  22.0 (3.0)       18.9 (4.0)   MB/sec word transfer rate (wait states).
  42.9 (3.0)       37.0 (4.0)   MB/sec 32-bit transfer rate (wait states).

  Overall cpu and memory performance (non-floating point) for typical
  DOS programs is 10.36 +/- 1.04 times an 8MHz IBM PC/AT.
  Protected/Real switch rate = 36156/sec (27 usec/switch, 15 up + 11 down),
  DOS/16M switch mode 11 (VCPI).
```

The top information line shows that the CPU performance is equivalent to a 67.0 MHz 80486. Below are the configuration and timings for both the DOS memory and extended memory. If the computer is not equipped with extended memory, or none is available for DOS/4GW, the extended memory measurements may be omitted ("--").

The line "according to BIOS" shows the information provided by the BIOS (interrupts 12h and 15h function 88h). The line "SETUP", if displayed, is the configuration obtained directly from the CMOS RAM as set by the computer's setup program. It is displayed only if the numbers are different from those in the BIOS line. They will be different for computers where the BIOS has reserved memory for itself or if another program has allocated some memory and is intercepting the BIOS configuration requests to report less memory available than is physically configured. The "DOS/16M memory range", if displayed, shows the low and high addresses available to DOS/4GW in extended memory.

Below the configuration information is information on the memory speed (transfer rate). PMINFO tries to determine the memory architecture. Some architectures will perform well under some circumstances and poorly under others; PMINFO will show both the best and worst cases. The architectures detected are cache, interleaved, page-mode (or static column), and direct. Measurements are made using 32-bit accesses and reported as the number of megabytes per second that can be transferred. The number of wait states is reported in parentheses. The wait states can be a fractional number, like 0.5, if there is a wait state on writes but not on reads. Memory bandwidth (i.e., how fast the CPU can access memory) accounts for 60% to 70% of the performance for typical programs (that are not heavily dependent on floating-point math).

A performance metric developed by Tenberry Software is displayed, showing the expected throughput for the computer relative to a standard 8MHz IBM PC/AT (disk accesses and floating point are excluded). Finally, the speed with which the computer can switch between real and protected mode is displayed, both as the maximum number of round-trip switches that can occur per second, and the time for a single round-trip switch, broken out into the real-to-protected (up) and protected-to-real (down) components.

11.2. Can't execute PC99.EXE

You can also try a "clean boot", but you must load the equivalent of HIMEM.SYS to give DOS4GW access to high memory. In DOS 6 and later you can bypass the loading of all or part of your AUTOEXEC.BAT and CONFIG.SYS files during boot by pressing <F8>. With previous versions of DOS you must rename your AUTOEXEC.BAT and CONFIG.SYS files and re-boot your PC.

In Windows 95 you can press F8 and then select "Previous version of DOS", if available.

11.3. Not enough memory to run PC99

Most of the current DOS applications on your PC run in what is called "real mode". Real mode has a severe limitation in that even with an advanced 486 or Pentium processor, you cannot have a program larger than around 600K. This is the so-called 640K DOS barrier.

To run larger programs, you can switch the processor into what is called "protected mode". This is quite hard for a program to do, since if it uses any DOS function (such as reading a file), the program must switch back into real mode. As a result, program developers, such as CaDD Electronics, tend to buy this capability from a third party. These "switching programs" are usually called DOS extenders and require a 386 or better processor.

PC99 uses the Rational Systems DOS extender to switch your PC into protected mode. This allows the processor to directly address all available memory in your PC. Rational Systems attempts to load PC99 above the first 4Mb of extended memory in your PC. However, if you only have 4Mb of memory, then you also need to free up as much conventional memory as possible. Conventional memory is the first 1Mb of your memory space.

On a modern multi-media PC, device drivers are nearly always loaded into conventional memory. These drivers can include CD-ROM drivers, scanner drivers, and special video drivers. When this happens, PC99 may not have enough conventional memory available to run.

You can check the amount of conventional memory available by:

```
> mem /c
```

The amount is shown under "Largest executable program size". This value should be around 600K. If it is less, you should first try to run MEMMAKER. This is a program supplied with DOS, and will attempt to make your use of conventional memory as efficient as possible.

If after running MEMMAKER you still do not have enough memory to run PC99, you can solve the problem by using a DOS startup menu. This allows you to configure your PC for different uses.

A DOS startup menu consists of entries in both your CONFIG.SYS and your AUTOEXEC.BAT files. These entries permit optional selection of blocks of commands. A sample CONFIG.SYS is shown below:

```
SWITCHES=/F
DEVICE=C:\DOS\HIMEM.SYS /TESTMEM:OFF
DEVICE=C:\DOS\EMM386.EXE NOEMS X=D000-DFFF
BUFFERS=10,0
FILES=25
DOS=UMB
LASTDRIVE=L
FCBS=4,0

[menu]
menuitem=standard
menuitem=pc99
menudefault=standard,5

[common]
BREAK=ON
NUMLOCK=OFF
DOS=HIGH

[standard]
DEVICEHIGH=C:\DOS\ANSI.SYS

[pc99]

[common]
rem STACKS=9,256
SHELL=C:\DOS\COMMAND.COM C:\DOS\ /e:1024 /p
```

This sample CONFIG.SYS file causes a menu to be displayed before DOS processes the file. The menu contains 2 choices:

```
1.    standard
2.    pc99
```

This display is caused by the block labelled [menu]. The "menudefault" entry will be selected after 5 seconds. DOS then processes the rest of the file. If you selected "standard" (or let it default), then only blocks marked [standard] or [common] are processed.

Unfortunately, there is no hard-and-fast rule about what to place in the blocks. But, for example, PC99 does not need to have a CD-ROM driver or a scanner driver loaded. By omitting these entries in the PC99 block, you will not load these drivers, and will therefore have more conventional memory available.

The entries in the CONFIG.SYS also link to the AUTOEXEC.BAT file, which is processed immediately after CONFIG.SYS. DOS sets a variable called %CONFIG% which can be tested. A sample AUTOEXEC.BAT file follows:

```
@ECHO OFF
PATH C:\DOS;C:\WINDOWS;C:\WP51;C:\;
rem sound blaster ------------------------------------------------------
SET BLASTER=A220 I5 D1 H5 P330 T6
SET SOUND=C:\SB16
rem other --------------------------------------------------------------
SET TEMP=C:\TMP
SET TMP=C:\TMP
GOTO %CONFIG%
rem 1. standard --------------------------------------------------------
:standard
C:\MOUSE\MOUSE SER
LH C:\DOS\DOSKEY
GOTO end
rem 2. pc99 ------------------------------------------------------------
:pc99
GOTO end
:end
LH C:\DOS\SMARTDRV.EXE /X
PROMPT $p$g
```

The GOTO %CONFIG% is the mechanism DOS uses to select blocks in AUTOEXEC.BAT. This variable was set in CONFIG.SYS to either "standard" or "pc99". The GOTO causes processing to jump to one of these labels. In a batch file, a label begins with a colon (:). So if you selected "standard", then the mouse driver will be loaded, and DOSKEY will be active. If you selected PC99, these will be absent.

Using these techniques, you can increase the amount of conventional memory available to PC99, while still having a "standard" PC for all other uses.

You can find more information in your DOS manual. You can also type

```
> help menuitem
```

at the DOS prompt.

Now, how to do this in practice. Before doing anything make a backup of your current CONFIG.SYS and AUTOEXEC.BAT files:

```
> cd \
> copy config.sys config.bak
> copy autoexec.bat autoexec.bak
```

Now use EDIT to make some changes to CONFIG.SYS

```
> cd \
> edit config.sys
```

Add these lines to the top of the file:

```
[menu]
menuitem=standard
menuitem=pc99
menudefault=standard,5
```

Leave a line of space and then type

```
[standard]
```

Then at the bottom of the file leave a line of space and then type

```
[pc99]
```

Save the CONFIG.SYS file (<Alt-F>, Save, <Alt-F> eXit), and reboot your PC. At the startup menu select "standard" (or let it time out). Don't select pc99 because nothing will be loaded. Except for the startup menu, there should be no other difference in the way your PC runs. All we have done is to add a startup menu.

Now you need to move some things around. Look at the sample file above. PC99 needs access to things like HIMEM.SYS, and your FILES and BUFFERS settings. Try to weed out things that PC99 will not use. The rule is, put things that both "standard" and "pc99" need into "common" blocks, and then separate out the other items. A good, but tiresome, way to do this is move one thing at a time. Fortunately, you probably only need to do this procedure once.

When you make a change, reboot the PC and make sure everything works. If you select "pc99", you should also confirm that you are freeing memory:

```
> mem /c
```

The value shown under "Largest executable program" should be growing.

Now add the GOTO %CONFIG% entry and labels in your AUTOEXEC.BAT file. Again arrange items into blocks. In the example file selecting "pc99" does not load the mouse driver in AUTOEXEC.BAT.

Keep up this procedure until you find that Rational Systems loads PC99 and does not complain. Then you will have a startup menu that allows you to run your standard PC, along with PC99.

11.4. Can't open COMn

You have mapped a TI RS232 port to a non-existent PC COM port. PC99 tried to open the port and failed. The mapping is done using CFG.EXE. You must run CFG.EXE, select RS232, and edit the entries so that they match your physical PC. For example, if you do not have a COM2, you can enter a value of 1 for TI RS232/2 (use COM1), or 0 (don't use TI RS232/2).

11.5. Can't open DSKn

PC99 tried to open one of the four disk files listed in PC99.CFG and failed. Run CFG.EXE and change the entry so that the path to the disk file is valid. In the directory C:\PC99\DSK you should have at least nine files: FMT21.DSK, FMT22.DSK, PFMT21.DSK, PFMT22.DSK, DSK1, DSK2, DSK3, DSK4 and PC99.DSK. FMT21.DSK represents a blank DSSD formatted TI disk. FMT22.DSK represents a blank DSDD formatted TI disk.

11.6. Can't open <filename>

PC99 tried to open one of the files listed in PC99.CFG. Run CFG.EXE and change the entry so that the path to the file is valid.

11.7. Error messages corrupt display

When PC99 encounters a severe error, it reports it to stdout. The message is printed on the screen following the last place that a printf took place. In Debug Mode 1 this is usually the "spinning wheel" that shows the keyboard CRU lines are active. The error message will wrap into the TI screen area corrupting the display. If the message is not fatal, you can press <Esc> to go to the debugger and then <c> to continue. PC99 will then redraw the TI screen correctly.

11.8. COM port problems

PC99 uses interrupt-driven assembly code developed by Greenleaf Software to drive the PC COM port. Although PC99 can use COM1-COM4 on an ISA PC and COM1-COM8 on an MCA PC, it is recommended that you try to use COM1 or COM2. To test the COM port, run CFG.EXE and then Test.

Alternatively, you can connect your PC to a TI RS232 port. In PC99 load Terminal Emulator I, Terminal Emulator II, Fast-Term or Telco. On your TI system load the same program, with the same communication parameters (baud rate, parity, and duplex). You should be able to type on either system and see the characters appear on the other system.

11.9. Printer problems

PC99 uses the BIOS interrupt 0x17 to drive the printer attached to the PC LPTn port. The printer must be a TI-compatible printer.

You must map the TI PIO port to the PC LPT port which is attached to your printer. You use CFG.EXE to do this. For example, if your printer is attached to LPT2, the entry in RS232, PIO is 2.

To test the printer from DOS:

```
> print
 Name of list device [PRN]: LPTn
 Resident part of PRINT installed
 PRINT queue is empty
> print c:\config.sys
```

If you do not get the "Resident..." message, then you have already installed the print driver, most likely in your AUTOEXEC.BAT file. Check the entry in AUTOEXEC.BAT to see which port is being used by DOS.

To test the printer from PC99, load TI Basic:

```
> 100 REM
> LIST "PIO"
```

PC99 has been tested with an Epson LQ-510, Star NX10 and Hewlett-Packard LaserJet IV printer.

An emergency workaround would be to print the file to disk. For example, TI-Writer allows you to do this. Then use dskout to extract the file and convert it using dv802asc. You could then use DOS PRINT to print the file, or import the file into a PC application, such as WordPerfect, and use its printer driver to print the file.

11.10. Known problems

In the program Miner 2049'er from Tigervision the miner (Bounty Bob) never dies. This is believed to be an aberrant sprite coincidence problem, and is being worked on.

You can make the following patch in the debugger to temporarily fix the problem and allow you to play the game:

```
Location    Old   New
>B022       13    16
```

12. Limited Warranty

12.1. Three-month limited warranty — PC99 Software Media

CaDD Electronics extends this consumer warranty only to the original consumer purchaser.

This warranty covers the case components of the software package. The components include the PC99 disks ("the Hardware"). This limited warranty does not extend to the Programs contained in the software media and in the accompanying documentation ("the Programs").

The Hardware is warranted against malfunction due to defective materials or construction. This warranty is void if the hardware has been damaged by accident or unreasonable use, neglect, improper service or other causes not arising out of defects in material or construction.

12.2. Warranty duration

The Hardware is warranted for a period of three months from the date of original purchase by the consumer.

12.3. Performance by CaDD Electronics under warranty

During the three-month warranty period, defective Hardware will be replaced when it is returned postage prepaid to CaDD Electronics at the address below. The replacement Hardware will be warranted for a period of three months from date of replacement. CaDD Electronics strongly recommends that you insure the Hardware for value prior to mailing.

12.4. CaDD Electronics Consumer Service Facility

CaDD Electronics,
45 Centerville Drive,
Salem, NH 03079-2674
603-893-1450 or 603-893-0119

12.5. Important notice of disclaimer regarding the programs

The following should be read and understood before purchasing and/or using the PC99 programs:

CaDD Electronics does not warrant the PC99 Programs will be free from error or will meet the specific requirements of the Consumer. The Consumer assumes complete responsibility for any decisions made or actions taken based on information obtained using the Programs. Any statements made concerning the utility of the Programs are not to be construed as express or implied warranties.

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